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SUGARBEET RESEARCH

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A Report to and for
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FOREWARD

SUGARBEET RESEARCH is an annual compilation of progress reports concerning incomplete research by Agricultural Research Service investigators and cooperators who are engaged in sugarbeet variety and production research. The report has been assembled and reproduced at the expense of the Beet Sugar Development Foundation, and is for the sole use of the cooperators. Much of the data has not been sufficiently confirmed to justify general release and interpretations may be modified with additional experimentation. The report is not intended for publication and should not be used for cited reference nor quoted in publicity or advertising. Reproduction of any portion of the material contained herein will not be permitted without the specific consent of the contributor or contributors.

The report presents results of investigations strengthened by contributicns received under Cooperative Agreements between Agricultural Research Service, U.S. Department of Agriculture, and the Beet Sugar Development Foundation; the California Beet Growers Association,; and the Sugarbeet Research and Education Board of Minnesota and North Dakota.

Trade names occur in this report solely to provide specific information and do not signify endorsement by the U.S. Department of Agriculture or the Beet Sugar Development Foundation.

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SUGARBEET RESEARCH

1985 Report

Section A

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Holly Sugar Corporation
Spreckels Sugar Division
Union Sugar Division
California Beet Growers Association

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ABSTRACTS OF PAPERS PUBLISHED

DUFFUS, JAMES E. Whitefly borne viruses. Proc. 5th Conf. of ISHS Working Group on Vegetable Viruses, p. 25. 1985.

The whitefly transmitted viruses, known in all continents except perhaps Antarctica, produce a wide and divergent group of diseases, most of which have not been characterized. The agents are transmitted by at least three whitefly species in the nonpersistent, semipersistent, persistent, and in biological mechanisms. The viruses cause significant losses throughout the world and although not considered as important as aphids on a worldwide basis, they are responsible for the natural spread of some 70 important diseases in the tropical and subtropical areas. The whitefly transmitted diseases have been characterized in general on the basis of their transmission by whiteflies and the activity of the agents on host plants, such as symptoms and host range. A compilation of available data on the viruses themselves would suggest at least seven groups of viruses differing in type of virus particle, symptom type, and vector relationships. These include geminiviruses, and viruses similar to the closteroviruses, carlaviruses, potyviruses, nepoviruses, luteoviruses and a DNA-containing rod-shaped virus.

DUFFUS, JAMES E., R. C. LARSEN, and H. Y. LIU. Lettuce infectious yellows virus--a new type of whitefly-transmitted virus. Phytopathology 76:97-100. 1986.

A new yellowing disease of lettuce, sugarbeet, carrot, and other crop and weed hosts was found in the desert areas of southwestern United States. The inciting virus (lettuce infectious yellows virus [LIYV]) was transmitted by the sweet potato whitefly (Bemisia tabaci) in a semipersistent manner, but it was not mechanically transmissible. The virus was retained by viruliferous whiteflies for 3 days in serial transfers on susceptible hosts. LIYV had a wide host range (45 species in 15 plant families) and caused economically significant losses in a number of important crop plants. The virus was purified by differential centrifugation and density gradient centrifugation. Purified preparations had an $A_{260\ 280nm}$ ratio of 1.28 and contained long flexuous particles 13-14 nm wide and 1,800-2,000nm long. An antiserum with a homologous titer of 1/1.024 showed no relationship to beet pseudo-yellows virus and could be used to detect greenhouse- and field-infected plants by the ELISA method. The host range, particle size, insect transmission, and serology clearly distinguished LIYV from previously described viruses.

DUFFUS, JAMES E., H. Y. LIU, and M. R. JOHNS. Melon leaf curl virus--a new geminivirus with host and serological variations from squash leaf curl virus. Phytopathology 75:1312. 1985.

A new whitefly-transmitted gemini virus causing leaf curl symptoms on melons has been isolated from the Imperial Valley, California. The infectious agent, melon leaf curl virus (MLCV), which affects melon, watermelon, cucumber, cantaloupe, pumpkin, squash and bean is transmitted by Bemisia

tabaci as well as being mechanically transmitted. MLCV virions appeared identical to squash leaf curl virus (SLCV) on the basis of particle morphology and ELISA tests. However, SLCV does not affect melon, watermelon and cucumber; also, SLCV antiserum did not react with MLCV in agar double diffusion tests.

HOEFERT, L. L., M. R. JOHNS, and JAMES E. DUFFUS. A possible seed-transmitted latent virus of Coriander. Phytopathology 75:1358. 1985.

A rod-shaped virus-like particle was isolated from symptomless plants grown from four seed lots of coriander (Coriandrum sativum L.). The presumed virus is found in relatively small concentrations in infected plants. Similar particles were found in anthers of coriander prepared for transmission electron microscopy. Rod-shaped particles were detected in tapetal cells of developing anthers, where the particles showed a spatial relationship to nuclei. An antiserum is now being prepared that will allow detection of the virus in coriander plants and will provide information that may be utilized in the study of transmission and host range of the virus.

LIU, H. Y. and JAMES E. DUFFUS. The viruses involved in Rhizomania disease of sugarbeet in California. Phytopathology 75:1312. 1985.

Rhizomania, one of the most destructive diseases of sugarbeet in Europe and Japan, was found in several of the important sugarbeet growing areas of California in 1983. Rhizomania is reported to be caused by beet necrotic yellow vein virus (BNYVV) vectored by a soil fungus, Polymyxa betae Keskin. In California, this disease was identified by the presence of BNYVV and P. betae in the roots of affected sugarbeet plants. Several distinct isolates of BNYVV have been found in California. All isolates reacted in ELISA tests with antiserum to Japanese and French isolates of the virus. Other virus entities different in symptomatology and virus particles have been found. The relationship of these entities to Rhizomania disease of sugarbeet is not yet known.

WOODRUFF, D. W., R. T. LEWELLEN, J. E. DUFFUS, and E. D. WHITNEY. An investigation into the effect of soil compaction and irrigation on sugarbeet infected with rhizomania. Soil & Tillage Res. 6(1-3), Special Issue. 1985.

YU, M. H. Resistance to Heterodera schachtii in Patellares section of the genus Beta. Euphytica 33:633-640. 1984.

Fifty-two accessions of the section Patellares wild beet (including 26 Beta patellaris Moq., 13 B. procumbens Chr. Sm. and 13 B. webbiana Moq.) and 14 progeny families were selected and tested against sugarbeet cyst nematode, Heterodera schachtii Schm. All Patellares species tested were highly resistant, but not immune, to the development of H. schachtii, after infection. This is the first report that mature female nematodes developed in the roots of B. webbiana plants. The occasional development of nematode cysts in roots of juvenile wild beets was, however, not a heritable genetic factor.

PERFORMANCE OF RESISTANT SUGARBEET GERMPLASM LINES IN THE NEMATODE INFESTED FIELD

M. H. Yu

For many years breeding of sugarbeet germplasm lines resistant to sugarbeet nematode, Heterodera schachtii, has been mainly conducted in the greenhouse. The greenhouse settings may facilitate better management on seedling germination, growth regulations, testing procedures, and close evaluation of the plants. Yet the confined greenhouse conditions are after all unnatural. Plants so grown are not exposed to natural environment and, therefore, may not develop or express up to their optimum or maximum genotypic potential. In 1985 several lines of nematode resistant and non-resistant sugarbeet germplasms were planted in a Gonzales sugarbeet farm to observe their performance under field conditions.

One highly nematode infested sugarbeet field that previously had been chosen was not used because of rhizomania infestation. A non-fumigated sugarbeet field, with moderate levels of nematode infestation but free from rhizomania disease, was therefore adopted for this trial. The sugarbeet material used included: the true breeding nematode resistant lines A62-G1, A62-G2 and H584C; the first generation resistant hybrid A62/F80-37; progeny populations that derived from interpollination of resistant heterozygotes or open-pollinated derivatives D295, H501, 7512, and H584-P2; and the non-resistant sugarbeet checks CK01, CK07, and CK66 that were selected from cultivars. The two non-Beta species plants, Maxi, Sinapis alba, and Nemex, Raphanus sativus, were both resistant to H. schachtii. They also were used as control in this study.

Seed was planted in 10-foot rows, 6 replications, in late February. Individual lines were assigned at random to single rows in each replication. Seedling germination was generally good, but varied. In several rows, some plants were lost during cultivation and weed control processes by the tractor. In early April an application of Temik, at 15 lbs. per acre level, was mistakenly applied by a farm worker. This treatment undoubtedly had caused undeterminate effects on the population dynamics of the cyst nematode in the soil. No further cultivation and weed control were practiced after April. Plants grown in thin stands and those in low growth profile were often shadowed partially, sometimes totally, by the surrounding grasses. Sugarbeets were harvested between the end of August and early September. While lifting taproots, soil samples of each row were randomly collected from around the root zone of individual plants.

There have been rather low numbers of nematode, less than 1 viable cyst per 200 ml of soil with no full cysts or white females, found in the rhizosphere of the resistant lines (Table 1). It was obvious that the true breeding nematode resistant lines and the first generation resistant hybrids displayed a highly significant suppressive effect on the development of sugarbeet nematode. This was in striking contrast to that of the non-resistant check plants where 50 or more full and viable cysts and white females were observed. The presence of noticeable numbers of nematodes in the rhizosphere of those progeny plants derived from resistant heterozygotes was expected, because

progeny of such resistant source tended to segregate non-resistant type in a large proportion. Only a low number of cysts were detected in the soil around Maxi and Nemex. This demonstrated that both these plants have a high level of resistance to H. schachtii.

Table 1. Sugarbeet nematode populations in soil around root system following the growth of resistant sugarbeets and check plants.

Source plants	Rhizosphere nematode population[a/]			
	Full cysts	Viable cysts	White females	Empty cysts
A62-G1	0	<1	0	55
A62-G2	0	<1	0	42
H584C	0	<1	0	54
A62/F80-37	0	<1	0	50
H584-P2	1	10	8	76
D295-2	2	27	16	98
H501-3	1	24	12	68
7512-2	1	22	14	109
CK01	2	40	25	109
CK07	3	32	13	95
CK66	1	30	17	80
Maxi[b/]	<1	2	<1	43
Nemex[b/]	1	5	1	50

[a/] Based on 200 ml of soil per sample, 6 replications.

[b/] Non-Beta species plants; resistant to H. schachtii.

The empty cysts do not necessarily represent the final, or the latest, nematode populations. This data, nevertheless, is a good indication of the size of pre-planting and post-planting nematode populations. This is reflected by the fact that there were more than 40 empty cysts per entry observed in every line of the resistant sugarbeets and non-Beta plants (Table 1).

Lines A62 and H384 had lower growth profile than other sugarbeet lines; consequently they encountered more competition from surrounding grasses. The average root weight per plant and root yield per row of the resistant sugarbeets were found to be inversely correlated to the dosage of nematode resistance in the sugarbeet genome in this study. These true breeding nematode resistant sugarbeets, presumably homozygous for nematode resistance, produced considerably low root yields in comparison to that of the control lines. A62 plants grew some sprangled roots. The first generation resistant hybrid A62/F80-37, on the other hand, produced significantly higher yields than its seed parent A62; yet such level of root yield still was lower than that of the better sugarbeet check lines. This suggested that further improvement is needed for these resistant germplasm lines. These three sugarbeet lines that derived from resistant heterozygotes, D295, H501, and 7512, have shown promising growth, vigor, and yielding capabilities. Resistant genotypes selected from these families would be a good source resistant material for the future improvement of nematode resistant sugarbeet.

FUMIGATION FOR THE CONTROL OF RHIZOMANIA

E. D. Whitney, F. Martin, J. E. Duffus, and R. T. Lewellen

A preliminary test with Vorlex, dichloropropene and methylisothiocyanate, in 1984 gave good increases in yield when sugar beets were grown in fumigated-rhizomania infested soil. To reevaluate Vorlex and other soil fumigants, a test was conducted in 1985. This is a preliminary report of these two tests.

Materials and Methods.

1984 test: Vorlex at 50 gallons per acre, 20 gallons of dichloropropene and 10 gallons of methylisothiocyanate, was manually injected at a six inch soil depth and covered with a plastic sheet on April 16. Two cultivars, US H11, susceptible, and Mono 1167, resistant, were planted May 16 in a randomized complete block design with 4 replications and harvested October 22 and 23. Root yields, disease index and sugar percentage were obtained at harvest.

1985 test: Three fumigants, dichloropropene, methylisothiocyanate and chloropicrin alone and in various combinations to equal nine treatments plus a check were used. The soil was rototilled prior to being bedded for planting. Fumigants were injected into beds at a 7 inch depth, rolled, and sprinkler irrigated following the treatment to seal the soil surface. Each treatment was 2 rows wide and had four replications in a randomized complete block design. The rate of each treatment per acre is shown in table 2. At planting, a V-shaped apparatus was used in front of the seeder to move the top 1 to 2 inches of soil into the furrows. One cultivar, US H11, was planted May 29 and harvested October 29. Cross ditches were made at the bottom of each block to divert runoff water to reduce water flow between treatments. Temik was applied to control nematodes, sulfur for mildew control, a herbicide for weed control, and pentachloronitrobenzene for Rhizoctonia control. Irrigation was by sprinklers. Harvested beets were similarly treated in the two tests with the exception that two samples were taken from each replication at harvest time for a serological (ELISA) test for beet necrotic yellow vein virus (BNYVV) in 1985.

Results.

All of the fumigation treatments gave some control. Vorlex in 1984 increased yield of both cultivars grown in infested soil, table 1. Without fumigation, the tolerant cultivar Mono 1167 was higher in yield than the susceptible cultivar, US H11. The most cost effective and efficacious treatment in 1985 was dichloropropene, table 2. In general, only those products with dichloropropene reduced root proliferation and percentage tare. Only Vorlex and the high level of dichloropropene gave season-long control as determined by the ELISA test for BNYVV at harvest. Cost per pound of the additional sugar produced in fumigated plots was lowest for dichloropropene, 3.4 and 2.1¢ per pound for the high and low rates, respectively.

Table 1. 1984 Fumigation Data.

	Sugar Yield	Root Yield	Sucrose	Disease Index[1]
	Lbs	T/A	%	
Nonfumigated				
US H11	2,040	10.8	9.4	4.0
Mono 1167	4,191	16.4	12.8	3.1
Fumigated[2]				
US H11	7,289	28.6	12.7	0.5
Mono 1167	7,774	27.8	14.0	0.2

[1] Disease Index 0 to 6; 0 = healthy, 6 = dead.

[2] 50 gallons vorlex.

Discussion.

The results of these tests suggest that under our conditions dichloropropene can effectively and efficiently control rhizomania. Methylisothiocyanate and chloropicrin gave some control and should be further tested. Whether adequate control could be achieved under sugar beet production will depend on a number of factors: soil type, method of fumigant application, use of sprinkler irrigation to seal the soil surface and other factors that may be peculiar to any given soil.

Although dichloropropene is registered for nematode control on sugar beet, the label would have to be upgraded to include its use for rhizomania control before it could be used commercially. Dichloropropene has also been shown to be effective in rhizomania control in West Germany (1).

Literature Cited.

1. Hess, W. and E. Schlosser, 1984. Rizomania. VI Befalls-verlust-relation und bekampfung mit dichloropopen. Med. Fac. Landbouww, Rijksumiv. Gent 49/ 2b:473-480.

Table 2. 1985 Fumigation Data

	Check	Vapam[1]	Telone II[2]	Telone II[2]	Vorlex[3]	Vorlex 201[4]	Pichlor[5]	Pichlor[5]	Chloro-picrin	Chloro-picrin
Rate (Gal/A)	0	8.5	8.5	3.5	15.7	17.3	7.9	4.4	5.4	2.5
Cost/Acre	0	60	85	50	250	295	215	120	85	160
Yield/Acre	11.5	16.3	20.0	19.3	20.3	21.0	22.3	19.5	18.0	16.3
Sugar %										
1. Root	11.5	12.1	12.4	13.2	12.9	11.8	12.2	12.9	12.3	12.5
2. Crown	10.8	10.1	9.7	10.1	10.0	9.1	9.5	10.0	10.0	10.2
Lbs. Sugar	2430	3680	4960	4790	4850	4860	5660	4750	4620	3660
% Tare	14	11	4	5	6	5	6	4	11	7
Cost/Lb.[6]	0	4.8	3.4	2.1	10.3	12.1	6.4	5.2	7.3	6.9
ELISA										
% Infected Beets	100	100	0	100	0	25	38	75	100	100
Disease Index[7]	3.1	2.4	.04	0.5	.01	0.2	.03	0.8	0.8	2.2

[1] methylisothiocyanate

[2] dichloropropene

[3] dichloropropene & methylisothiocyanate

[4] dichloropropene, methylisothiocyanate, & chloropicrin

[5] dichloropropene, & chloropicrin

[6] Cost/Lb. = Fumigation Cost/Yield lbs - Yield lbs of check

[7] Disease index 0 to 6; 0 = healthy, 6 = dead

SUGARBEET GENETICS, BREEDING, AND GERMPLASM IMPROVEMENT - SUMMARY OF TRIALS FOR 1985

R. T. Lewellen and I. O. Skoyen

DIFFERENTIAL REACTION OF SUGARBEET TO LETTUCE INFECTIOUS YELLOWS VIRUS--LIYV was severe in the Imperial Valley in 1985 causing an estimated 25% loss. Trials grown at Brawley were likewise naturally infected and the results of Tests B185 through B785 summarized in this report were under the influence of 100% infection. Observations of the Imperial Valley trials as they relate to LIYV infection are given in the remarks section of the introduction to these trials. Briefly, the results of the 1985 trials show that variability exists within sugarbeet for differential host-plant reaction to LIYV.

EVIDENCE OF DIFFERENTIAL HOST-PLANT REACTION TO LIYV

Hybrid	GSY/A	RY/A	%S	% tare
Salinas, 1984				
S_2-216-14 x C46	12,250	34.3	17.9	
S_2-216-26 x C46	11,850	33.4	17.9	
Brawley, 1985				
S_2-216-14 x C46	7,550	27.0	14.0	6.1
S_2-216-26 x C46	3,590	16.1	11.2	14.1
Brawley, 1985				
C306 x Pollinators[1/]	8,500	30.2	14.1	
546H3 x Pollinators[1/]	6,800	24.0	14.3	
546H3 x C36[2/]	6,700	24.9	13.4	
Salinas, 1984				
KW1132	12,500	34.2	18.3	
C309 x C46	11,800	32.9	18.0	
Brawley, 1985				
C309 x C46	7,500	25.4	14.7	7.6
KW1132	5,200	17.4	15.0	12.7

1/ Pollinators = C37, C31/4, & C46.
2/ US H11.

The best source of resistance observed in these trials originated from popn-755 or lines extracted from it. In particular, lines C301, C303, and C306 among those released showed tolerance or resistance as measured by sugar yield performance in experimental hybrids. One pair of S_2-TX hybrids that were nearly equal in performance at Salinas in 1984 in the absence of LIYV were greatly different in performance at Brawley in 1985. Synthetics of popn-755 (Test B685) that were developed following progeny tests in Imperial Valley in 1982 under severe LIYV infected conditions also showed significantly different performance in 1985. Although all plants in all lines showed visual evidence of LIYV infection, it appeared that sufficient genetic variability for resistance is available to greatly ameliorate the effects of this damaging disease.

S_1-PROGENY RECURRENT SELECTION--The evaluation of S_1 progeny recurrent selection is the continuation of an ongoing program to test this intrapopulation

improvement method within sugarbeet. See pages A16-19 in the 1984 Report and pages A13-A14 in the 1983 Report. The tests for 1985 are summarized as 1285-1 and 1285-2 grown at Salinas and B785 from Brawley. Three cycles of selection have now been completed and synthetics per se were compared to their source popn-790(C0).

RESPONSE OF POPN-790 TO 3 CYCLES OF S_1 PROGENY RECURRENT SELECTION FOR SUGAR YIELD

	% Gain		
Cycle	GSY	RY	%S
C0	0.0	0.0	0.0
C1	7.4	7.8	-0.1
C2	14.0	12.9	0.9
C3	18.6	15.4	3.0

Mean of 2 tests at Salinas and one in Imperial Valley in 1985.

The improvement in the third cycle was not as proportionally large as the improvement for cycles 1 and 2. This smaller increase may be a reflection on the 1983 S_1 progeny test per se (see pages A13-14, 1983 Report) and not a decrease in the remaining genetic variability. The 1983 S_1 progeny test had extreme pressure from Pythium at the seeding stage and for root pruning through the remaining season and these lines may not have grown to their potential. There was evidence of differential performance to Pythium among these progenies. Of the 96 S_1 progeny families tested in 1983, 16 were selected to produce the C3 synthetic. Of the 16 selected lines, six lines were individually increased and released as popn-C790(C3). However, seed of each S_1 family increase was maintained and distributed separately as C790-2,-41,-42,-55,-65, and -68. Except for the per se performance of these lines for curly top, bolting, Erwinia, and powdery mildew (Tests 185 and 3085), no performance data are yet available. In 1985 bulk increases of these lines and their CMS counterparts were topcrossed to C46/2 and will be evaluated for hybrid performance at Brawley and Salinas.

DOES VARIABILITY FOR TOLERANCE TO PYTHIUM ULTIMUM OCCUR WITHIN SUGARBEET?--In a 1983 S_1 progeny test (page A13-14, 1983 Report), a seedling malady occurred that caused damping-off, stunting, and root pruning. Plot ratings showed that the problem was consistent over replications. The etiology of the problem was not determined at that time but circumstantial evidence has since suggested that infection by Pythium ultimum was responsible. In similar planting times in 1984 and 1985, P. ultimum was isolated from seedings with similar symptoms. Apparently the field soils become very conducive to P. ultimum as they warm in late February to early April. Plantings made earlier or later are relatively free of damping-off due to this fungus. Also in 1983, S_1 progenies were planted into soil from this site in greenhouse tests and a general association occurred between the observed field ratings and greenhouse ratings for seedling survival.

In 1985, Dr. Frank Martin, a Post Doc. working on rhizomania and soil-borne diseases, tested six of these S_1 lines in greenhouse tests and challenged them specifically to P. ultimum.

HOST-PLANT REACTION TO PYTHIUM ULTIMUM

S_1 progeny family	1983 Field	1983 Greenhouse	Corrected Survival[3/] Test 1[4/]	Test 2[5/]
	rating[1/]	rating[2/]	%	%
2790-4	5.0	4.0	23.4	35.2
2790-6	1.7	3.0	44.2	67.9
2790-7	4.7	6.0	31.7	34.7
2790-15	1.0	1.0	41.0	65.7
2790-16	4.0	6.0	22.8	47.0
2790-23	1.3	4.0	28.1	46.2
SP6822-0	-	5.0	5.9	21.2

1/ 96 S_1 progenies evaluated where 1 = good survival and vigor and 6 = very poor survival. Test mean = 2.6, range 1.0 to 5.0, LSD (.05) = 1.5.
2/ Selected lines rated in soil in greenhouse.
3/ % survival corrected for level of emergence in sterilized Oceano loamy sand.
4/ Autoclaved Oceano loamy sand, 20 seeds per pot, 4 replications, 43 propagules of P. ultimum per gram of soil, surviving plants after 18 days from emergence.
5/ Autoclaved Oceano loamy sand, 30 seeds per pot, 4 replications, 100 propagules of P. ultimum per gram of soil, surviving plants after 25 days.

The greenhouse data were in general agreement with the field plot data and suggested differential host-plant tolerance to Pythium. This may be important if resistant genotypes could be used to avoid seedling loss and root pruning, particularly if registration problems occur for protective seed treatments. We are unaware of any other report of tolerance in sugarbeet or beet crops to Pythium. Usually beet is considered so susceptible that it is used as a biological tester to identify and index soils and seed treatments to Pythium. SP6822-0 was used as a check variety because of its resistance to Aphanomyces. The reaction of SP6822-0 in field trials at Salinas and in these greenhouse tests suggests that reactions to Pythium and Aphanomyces are independent.

SOURCES, PEDIGREES, AND COMMONALTY OF GERMPLASM IN MM, $S^{s}S^{s}$ BREEDING LINES RELEASED FROM SALINAS--C31 (C01, C31, C31/2, C31/4, C31/6): C31/6 will be released in 1986. C31/6 resulted from two additional cycles of mass (individual plant, mother root, or phenotypic recurrent) selection for combined disease resistance and productivity from C31/4 and a total of nine cycles of selection from the F_2 of the original composite cross source. Individual and combined selections have been for resistance to virus yellows (BYV and/or BWYV), Erwinia root rot, powdery mildew, rust, downy mildew, and bolting and for individual root performance for sucrose concentration, weight, and root and crown conformation. The original composite cross was made in 1965 and lines were released in 1974 (C01), 1975 (C31), 1978 (C31/2), 1981 (C31/4) and 1986 (C31/6). The composite cross included germplasm from curly top resistant lines US 75, US 22/3, US 56, C13, C321 & C671 (T-O composites), and C663; SLC 15mm and SLC 320mm; C534 and other lines from the Netherlands; C953 (T-O Klein E); accessions from England including Sharps' E and yellows resistant selections from Rose 1014 & 1011; and PI 224227 (Gaskill's increase of IRS 55 M14). All of these sources had been previously selected for resistance

to virus yellows by McFarlane and Skoyen at Salinas, Dr. Reitberg in the Netherlands, or Dr. R. Hull in England. The composite cross was produced by Hecker, McFarlane & Skoyen in 1965. Subsequent increases and cycles of selection were made by Lewellen & Skoyen at Salinas.

Earlier releases of this broadbased breeding line have already been used directly or as a source to extract pollinators for important commercial hybrids grown in California. As long as improvement is possible and useful levels of genetic variability evident, we will probably continue to reselect within this line. As new needs arise, for example for resistance to rhizomania, this line will be used as a basic germplasm resource for intra- and inter-line crosses, selection, and recombination. C31 has been tested as breeding line Y_31 where _ = year of seed production, for example, Y531 = 1985 production.

C39: C39 will be released in 1986. This will be the initial release from this breeding line that has been improved and advanced by six cycles of individual plant selection. Within each cycle, selection for one or more traits has been emphasized, e.g., for resistance to virus yellows, Erwinia root rot, powdery mildew, and/or bolting and for productivity (individual root weight and sucrose concentration). The original composite cross was made in 1973 and selection started following one generation of recombination. This line is broadly based and was produced from approximately the following germplasm sources: C13 & C17 (35%); C01 (12%); C534 (11%); C264, C321, C585, US 75, US 56, & US 15 (26%); SP6822-0 (5%); FC 701/2 & FC702/2 (8%); and Acc. 122 = VDH-VT p.c. 1470-66 (3%).

As a line per se, C39 has good sucrose concentration, long smooth roots, moderate resistance to virus yellows, powdery mildew, Erwinia root rot, and bolting, and moderate susceptibility to curly top. Of all lines with adaptation to California tested for reaction to rhizomania, C39 has had the lowest disease score and the highest yield under infected conditions. In infested soils, C39 appeared to be equal or superior to "tolerant" sources accessed from Europe. C39 appears to be an important source of genetic variability for resistance to rhizomania. Presently in our breeding program, roots from the second cycle of rhizomania resistance selection are being photothermally induced. Line C39 has been evaluated as breeding line Y39 and in the future, rhizomania resistant selections will be evaluated as R39.

C49: C49 will be released in 1986 from the combined disease resistance program at Salinas. C49 combines the traits of lines C13, C17, C36 & C37 with C31. From the F_2 of the initial composite cross, three cycles of mass selec- have been made for resistance to virus yellows, Erwinia root rot, and powdery mildew with continued emphasis on high sucrose concentration. C49 has been evaluated as breeding line Y49.

C91: C91 was released in 1985. C91 was derived by mass selection for combined disease resistance and sucrose percentage from a cross between the lines C64 (C264) and C01. C91 has been evaluated as breeding line Y41 and has shown good resistance to virus yellows, powdery mildew, and Erwinia root rot.

C92: C92 was released in 1985. It was derived from a composite cross between

C37 and Y41 (see C91) by mass selection for resistance to virus yellows, Erwinia root rot, and powdery mildew. Emphasis was placed on improving the sucrose content in a line with traits similar to C37. C92 has been evaluated as breeding line Y52.

C46 (C46, C46/2): These lines were released in 1981 and 1984 from the backcross of line C17 with C17 x C264 (C64). C46 has been evaluated as lines designated Y46.

C42: C42 was derived from the cross C264 x C04. C04 was an improved line derived from C13 x C534. C42 was released in 1980 and tested as line Y42.

C22: Released in 1975, C22 was an improved line that was derived from C13, C17 x C04 (see C42). As with C42, the second cross was used to improve curly top resistance.

C15: C15 was derived from the fifth consecutive cycle of mass selection for yellows resistance from obsolete variety US 15. C15 was released in 1982. It has been evaluated as line Y23.

C16: C16 and its counterpart C16CMS were released in 1978 and derived from C17 by three cycles of type-O selection.

C19: C19 (and C19CMS) also was released in 1978 as a type-O version of C534.

C32, C43: These lines released in 1978 are similar to line C31 and C17. C17 and C31 were recurrent parents in a breeding program to transfer single gene resistance to beet mosaic virus from an annual line. They have a high frequency of the allele Bm that confers high resistance to BMV.

C13, C17, C36, C37: These widely used parental lines are one of two primary sources for resistance to virus yellows. All are cognates that trace to US 75. C37 from C17 and C36 from C13 are Erwinia root rot resistant versions.

C534: This line is the other primary source of resistance to virus yellows. C534 originated in Dr. H. Reitberg's virus yellows resistance program in the Netherlands and was reselected in California by McFarlane and Skoyen.

C663, C264 (C63, C64): Curly top resistant, nonbolting lines from a cross between US 22/3 and US 15 released by McFarlane in 1956 and 1962.

US 75 (C68): An obsolete O.P. variety developed by McFarlane. Derived from US 22/3 by mass selection for nonbolting and resistance to downy mildew. US 75 (breeding line 68) is still used in the Salinas program as a standard check.

US 22/3: High curly top resistant source derived from US 1. This most important source of curly top resistant germplasm traces to composited lines from many cycles of selection and programs working toward curly top resistance. Its principal background germplasm may be 'R & G Old Type'. Hybrid varieties such as US H9, US H10, and US H11 may have as much as 87% of their germplasm that traces directly to US 22/3. Introduction of non-US 22/3 germplasm resulted primarily from the use and incorporation of the genes for

monogerm and self-fertility.

US 15: Curly top resistant and nonbolting selection from 'R & G Pioneer' type germplasm.

C31, C39, C49, C91, C92, C46, etc. represent different combinations and recombinations of germplasm that have resulted from the program to combine multiple disease resistance with improved performance traits. By and large these lines are similar in their resistance to virus yellows, are sources for high resistance to bolting, Erwinia root rot and powdery mildew, and all should be useful for extracting lines with high GCA for sugar yield. The level of curly top resistance is more or less proportional to the curly top resistant germplasm in their background. Compared to their primary germplasm sources, they are significantly improved for sucrose concentration, particularly under diseased conditions (see Tests 2784, 2385). These lines should be evaluated individually as lines per se or as specific sources for progeny families and recurrent selection. However, most of these and other yellows resistant releases may best be recombined to form a single working source population for further improvement and from which lines, progeny families, or pollinators could be extracted.

This presentation is not intended to be an all encompassing catalog or summary of the germplasm base of the multigerm O.P. breeding lines released from Salinas. Rather, it is a thumbnail sketch to show general relationships and commonalty of the germplasm in our recent releases. For more detailed information, reference should be made to the original BSDF and official USDA release notices and for some lines to registrations in Crop Science. The releases of McFarlane and Skoyen through 1964 are given in the J. ASSBT 13: 555-562 (1965). For older germplasm lines and obsolete varieties, check the index of the P. ASSBT under variety name and number, e.g., US 15 and US 75. Also, releases prior to 1972 are listed under "New Developments in Breeding Research" in the Sugarbeet Research (Bluebook) Reports.

PROGENY EVALUATION, RECURRENT SELECTION, AND THE DEVELOPMENT OF C309--Several types of selection and progeny evaluation procedures to improve population performance are being evaluated at Salinas within monogerm germplasm. Included in these breeding methodology studies is the use of S_1 and S_2 progeny performance per se, testcross (half-sib) progeny evaluation where S_1 or S_2 families are topcrossed (S_1-TX and S_2-TX evaluation, respectively), modified single-seed descent (SSD), bulk-population selection within composited S_1 and S_2 progenies, and mass selection. The interim results of these evaluations and trials are presented as test summaries throughout this report. Individual test clarifications or observations are included as footnotes to some tests. Because S_1-TX progeny evaluation has been the most extensively evaluated, the mechanics of this procedure as used by us will be illustrated using the development of cycle 1 synthetics 755J,K,L, & M (Tests 1085-1, 1085-2) and line C309 as examples.

S_1-TX (half-sib, topcross, testcross) progeny evaluation was chosen as a feasible and realistic procedure to improve sugarbeet populations for hybrid performance and to identify specific genotypes (S_0 plants) that have superior GCA and could be shunted-off and tested as potentially elite sources for parental line development. This of course assumes that early testing of S_1

progeny families will identify or discriminate differences in CA. The first cycle of selection has been completed for several sets of progenies from popn-755 (and others). The results from these first cycle selections are mixed. For example, see Tests 1085-1, 1085-2, B685, and 1185-2 in this report. Among other possibilities, these results demonstrate that the success of S_1-TX evaluation is partially contingent upon the efficacy and precision of the progeny evaluation phase to discriminate differences among a set of S_1 progenies. The differential performance of progenies evaluated in 1982 (Tests 1085-1,-2) were obviously superior to those tested in 1983 (Tests 1185-1,-2). In fact, the single replication in the Imperial Valley in 1982 provided better separation than four replications did in a similar set of progenies at Salinas in 1983. Even though improvements in the C1 synthetics for performance per se or in their variety hybrids have not been outstanding overall, individual S_1 progeny families (or S_0 plants) have been identified that perform well. For example, lines C301, C303, C306, and C309 were initially identified in the S_1-TX progeny trials and these and other S_1 families have been increased, reevaluated, and released. That is, S_1-TX trials have been predictive of superior CA or disease resistance. These results are similar to those described for corn. From similar progeny testing programs, corn inbred lines B73 and B84 were initially selected on the basis of early testing in recurrent selection and have been extensively used in commercial hybrids.

As a case in point and as a specific example of how breeding lines are handled or sequenced in this sugarbeet breeding program at Salinas, the development of C309 will be presented in some detail. Monogerm, self-fertile line C309 (S_0 plant = 9755-46; S_1 line = 0755-46; and Salinas breeding line 3755-46 and 816) was identified in 1982 and released in 1985 on the basis of its performance in early progeny testing. In 1980, about 120 S_0 plants heterozygous for genetic ms ($\underline{A}\underline{a}$) from popn-755 (C2 by mass selection) were selfed in the greenhouse to produce S_1 progeny seed (6 grams of seed produced of 0755-46). Simultaneously, the S_0 plant was crossed to an annual CMS tester to check for type-O. In August of 1980, 3 grams of seed of 0755-46 were planted in an Oregon steckling nursery. In 1981, the ms ($\underline{a}\underline{a}$) segregates from within each S_1 family were topcrossed to C37 at Salinas in a field seed plot. For S_1-755-46, 7$\underline{a}\underline{a}$ plants produced 240 grams of S_1-TX seed for progeny testing. Type-O indexing in the greenhouse showed the original 9755-46 S_0 plant to be type-O or near-type-O and examination of the S_0 plant when bagged, the S_1 seed, and the S_1-TX seed showed good quality monogerm traits.

In 1982, 84 S_1-TX progeny families were selected for evaluation in a three replication incomplete block progeny test at Salinas and one additional replication was grown in the Imperial Valley. On the basis of these progeny tests, C309 (S_1-755-46) was flagged for retesting and for increase. In addition, stecklings of this line and the other selected S_1 progeny families produced from remnant seed planted in August of 1982 were combined to produce seed of the first cycle synthetics (see 1085-1, 1085-2, and B685) of popn-755 (3755J, 3755K, 3755L, & 3755M) in 1983. The original S_1-TX seed (E137HL45-46) was used for a single, eight replication retest in 1983. Also, in 1983, stecklings produced from remnant S_1 seed were selfed ($\underline{A}\_ \otimes$) and/or sibbed ($\underline{a}\underline{a}$ x $\underline{A}\_$) in the greenhouse to produce 3755-46 (39 grams of seed from 8 plants).

In 1984, 3755-46 was increased in one greenhouse isolation chamber (350 grams

Comparison of C309 vs C546H3 in tests at Salinas and Brawley from 1983-1985

Year, Type Test No.(Page No)	C546H3 x ♂ GSY/A	T/A	%S	C309 x ♂ GSY/A	T/A	%S
1983, Retest of S_1aa x C37						
1583 (A30)	6,970	21.0	16.7	7,500	20.8	18.0
1984, Retests of S_1aa x C37						
1684 (A33)	11,570	34.8	16.6	11,840	32.9	18.0
1784 (A44)	11,990	34.9	17.2	12,660	34.5	18.4
1984, Brawley test of S_1aa x C37						
B684 (A63)	9,830	28.7	17.2	9,400	26.3	17.9
1985, 3755-46aa x C46						
685	13,760	40.2	17.1	14,220	39.1	18.2
785	14,230	42.9	16.6	14,530	40.6	17.9
885	14,290	43.2	16.5	14,030	40.3	17.4
1585	16,500	46.3	17.8	17,400	45.3	19.2
1685	14,720	43.0	17.1	17,150	45.9	18.7
1785	16,600	49.7	16.7	17,320	49.3	17.6
1885	16,310	48.0	17.0	18,210	50.8	17.9
1985, Virus yellows test						
2285-Noninoc.	12,780	38.7	16.5	14,760	41.2	17.9
2285-BWYV	11,680	36.4	16.1	13,960	40.6	17.2
1985, Brawley (LIYV infected)						
B485	6,590	23.1	14.2	7,450	25.4	14.7
B585	6,500	23.7	13.7	7,460	25.4	14.7
3 yr. means	12,300	37.0	16.5	13,200	37.2	17.6

Comparison of C309 vs C562 and/or C546 for bolting and reaction to diseases

Test & Disease Erwinia-DI	Lines per se C562	C546	C309	Hybrids with C546H3	C309
2183				7.7	6.3
2984	44.5	6.4	3.4		
3085	17.5	5.2	2.3	5.9	3.1
Powdery Mildew Rating					
2183				6.5	6.5
2984	5.3	6.0	6.6		
3085	5.9	5.9	7.4	6.3	7.5
Curly Top - Idaho					
1984	3.5	3.9	4.2		
1985	1.8	1.8	2.5	1.4	1.8
Bolting %					
185, 285	13.2	2.2	2.6	0.0	0.0

of seed with 97% germination and 98% single seedballs) along with the CMS counterpart of the 755 population. These seed lots were reassigned the permanent breeding line numbers 816 (4816 for 1984 seed) and 816CMS (4816CMS). Lines 4816 and 4816CMS were increased in Medford and Salinas isolation plots in 1985 to produce 5816, 5816CMS, and F_1CMS hybrids with 816 as the type-O. Seed released from the BSDF shared plot at Medford was coded C309 and C309CMS (F85-309, F85-309CMS).

Other than for random drift, the genetic heterogeniety of C309 should be equal to that of the original S_0 plant (equivalent to one clone from a self-sterile line); i.e., for every locus for which the alleles were not homozygous, there would be segregation. Thus some genetic variability remains that could be capitalized upon in a reselection or pure lining program. Bulk increases from both fertile ($\underline{A}\_$) and ms ($\underline{aa}$) plants were used to produce 4816 and 5816 (309) at Medford. At Salinas, seed was harvested only from tagged ms plants to produce 5816. So C309 may be a mixture of S_0 to S_4 plants. Either genetic ms ($\underline{aa}$) segregates or the CMS version of C309 can be and have been used to produce experimental single-cross hybrids.

Following the favorable performance of the original S_1-TX in 1982 and 1983, ms plants within increases of the S_1 line were topcrossed to C46 in 1984 and to C92 in 1985 for further evaluations. The experimental single cross 3755-46aa x C46 was extensively evaluated in tests in 1985 at Salinas and Imperial Valley. These evaluatins involving C309 are summarized in tabular form in comparison to the corresponding hybrids with widely used C546H3 (C562CMS x C546).

The S_1-TX breeding method as described above thus appears to have sufficient merit to be one approach used in a comprehensive germplasm improvement program. It offers the potential for improving a source population for hybrid performance while simultaneously allowing the breeder to identify and extract superior genotypes that may have potential as sources of parental lines. Selfing to produce S_1 families for testing and topcrossing allows the specific genotype of the S_0 plant to be retained without relying upon cloning or other asexual propagation problems. If sufficient S_1 seed is produced, supplemental S_1 progeny testing for disease resistance, etc., offers a powerful tool to improve traits that are conditioned by both additive and nonadditive effects. The genetic ms segregation in the S_1 progeny family or in subsequent increases, allows the breeder to immediately utilize these lines to produce single-cross hybrids for wide scale testing. In addition, if multigerm populations with similar genetic structure ($\underline{S}^f$, $\underline{A}$:$\underline{aa}$) were available (see test 2485) a natural sequence might be to pair populations that have the greatest heterotic response (see tests 1785, 2085, 2285) and use one as the tester for the other, and vice versa, to have a kind of reciprocal recurrent selection program. From the standpoint of the resources available within our germplasm improvement program, critical breeding work can be done in the greenhouse with "crossing tents" no larger or more complicated than a #20 white paper bag, bamboo stake, and twist-em and in spatial field seed plots where many lines (S_1, S_2, etc. progeny families) can be simultaneously crossed to one pollinator without artificial, expensive, and labor intensive mechanical barriers to extraneous pollination.

FIELD VARIETY TRIALS, SALINAS, CALIFORNIA, 1985

Location: USDA-ARS Agricultural Research Station

Soil Type: Sandy loam (Chualar series)

Previous crops: 1985 Sugarbeet test areas, Spence Field: Block 5 - 6.25A, Block 6 - 14.56A; fallow 1981-84, sugarbeets 1981.

Fertilizer used: Preplant: Block 5, 524 lbs/A 8:20:10 broadcast and chiselled in, Block 6, 421 lbs/A 8:20:10 broadcast and chiselled in prior to listing. Before seeding, about 330 lbs/A ammonium sulfate was Bye-Hoe incorporated in a 9-inch band into the beds.

Supplement nitrogen: One to three applications, as sidedress ammonium sulfate or by sprinkler system as 32% nitrogen in a liquid formulation.

Total fertilization (lbs/A);	N[1/]	P_2O_5	K_2O
Block 6	300	84	42
Block 5	180	105	52

1/ Depending on seeding date.

Summary: 1985 Tests at Salinas (Spence Field):

Test No.	Sowing Date 1985	Thinning Date 1985	Test Entries No.	Reps No.	Plot Row No.	Plot Lgth. Ft.	Harvest Date 1985	Test Design
185	1/10	2/28	144	2	1	27	--	--[1/]
285	1/11	3/1	144	2	1	27	--	--[1/]
385-1	1/11	3/4	48	5	1	30	10/25-26	SB[2/]
485	1/11	3/5	16	8	2	30	9/10-11	RCB
585	1/11	3/7	20	8	2	30	9/23-24	RCB[3/]
685	1/14	3/8	24	8	1	30	9/26	RCB
785	1/14	3/11	32	8	1	30	9/11-12	RCB
885	1/14	3/12	32	8	1	30	9/16-17	RCB
985-1	1/14	3/13	16	8	1	30	9/19	RCB[4/]
1085-1	1/14	3/13	8	8	1	30	9/19	SP
1185-1	1/14	3/14	8	8	1	30	9/19-20	SP
1285-1	1/14	3/15	8	8	1	30	9/20	RCB
1385	2/4	3/20	64	4	1	30	9/17-18	RCB[4/]
1485	2/4	3/22	16	8	1	30	10/3	RCB
1585	2/4	3/25	16	8	1	30	10/4	RCB
1685	2/4	4/1	16	8	2	30	10/1-2	RCB
1785	2/5	4/2	32	8	1	30	9/30-10/1	RCB
1885	2/5	4/4	32	8	1	30	10/7-8	RCB
2085	2/5	4/5	16	8	1	30	9/27	RCB
2185	2/26	4/5	18	8	1	30	9/24-25	RCB[3/]
2285	2/26	4/8	16	8	1	30	10/8-9	SB

Test No.	Sowing Date 1985	Thinning Date 1985	Test Entries No.	Reps No.	Plot Row No.	Plot Lgth. Ft.	Harvest Date 1985	Test Design
2385	2/26	4/8	16	8	1	30	10/15-16	SB
2485	2/26	4/9	6	8	1	30	10/16-17	SB
2585	2/26	4/9	10	8	1	30	10/10-11	SB
2785	4/19	5/16-17	16	8	1	30	10/23	RCB
2885	4/19	5/17	16	8	1	30	10/23-24	RCB
2985	4/19	5/20	8	8	1	30	10/17	RCB
3085	4/18	5/20	192	2	1	20	--	5/
3185	4/18	5/20	60	4	1	20	--	6/
3285	4/18	5/21	12	4	1	20	--	7/
385-2	4/19	5/21	16	4	1	30	10/17	RCB 4/
985-2	4/19	5/21-22	16	4	1	30	10/17	RCB 4/
1085-2	4/19	5/22	8	8	1	30	10/29	SP
1185-2	4/19	5/22	8	8	1	30	10/29	SP
1285-2	4/19	5/22	8	8	1	30	10/29	RCB

1/ Tests 185 and 285, bolting obs. tests - not harvested.
2/ Split block.
3/ Coded variety trials (Area 4).
4/ Incomplete blocks.
5/ ERR-PM Obs. test - Spence Field - not harvested.
6/ Comm. ERR-PM Obs. Test - Spence Field - not harvested.
7/ Misc. ERR-PM Obs. Test - Spence Field - not harvested.

Irrigation: By either furrow or sprinkler system as required at 7-14 day intervals except during stand establishment when frequent light sprinkler irrigations were used.

Herbicide use: Nortron at an average rate of 0.5 gal/A and Pyramin W, at an average rate of 3.0 lbs/A, or 2.5 qts/A Pyramin FL, were sprayed post plant and watered in with 1/2 to 3/4 inch sprinkler irrigation. Poast applied for grass control August 1, 1985.

Disease and insects: Natural virus yellows infection (BWYV) was moderate in January and March seeded tests and moderately severe in April and May seedings. Insect infestations were minor throughout growing season.

Powdery mildew was severe in 1985 where it was not controlled and appeared first (late June) in the earliest seeded tests. Excellent control was obtained with a single application of Bayleton. Spray applications of Bayleton, depending on appearance of P. M. in later seedings, at a rate of 8-10 oz ai/A were made after July 1, 1985.

Downy mildew infection was nil in 1985.

Natural infection of Erwinia soft rot was moderate in susceptible lines in 1985. Impact on yield was slight. Counts of rotted roots were made at harvest. Roots with rot were eliminated from the sugar samples.

Sugarbeet nematode was observed in isolated spots in 1985 test areas but had a slight effect on yield.

Seeding diseases: Pythium was moderate in late February seeded trials and caused moderate stand reductions. Differential varietal (seed treatment) responses were evident.

Southern root rot (Sclerotium) was observed in a few roots in B5 trials.

Rhizomania was observed in later seeded 1985 tests in Block 6 only.

Sugar analysis: Determined from two samples per plot of approximately 10 roots each or 25-40 lbs. of roots at the sugar analytical laboratory, U.S. Agricultural Research Station, Salinas, California.

Remarks: The 1985 test results have good reliability. Except for two or three tests, CV's were under 10% for yield components.

The assistance of Patricia Carpenter in the analyses of test data is gratefully acknowledged.

TEST 485. EVALUATION OF 546H3 x MULTIGERM BREEDING LINES, SALINAS, CA 1985

8 reps x 16 varieties, RCB
2-row plots, 30 ft. long

Planted: January 11, 1985
Harvested: September 9-10, 1985

Variety	Description[1/]	Acre Yield Sugar	Acre Yield Beets	Sucrose	Bolting	Root Rot	Beets/ 100'	Non Sucrose SS	Raw J. App. Purity	Extract. Sugar
		Lbs	Tons	%	%	%	Number	%	%	Lbs/T
Y446H37	F83-306CMS x F82-46	15,686	47.92	16.37	0.3	2.2	139	2.81	85.3	279
Y431H8	F82-546H3 x Y331(C31/5)	15,641	47.85	16.35	0.2	1.5	140	2.68	85.9	280
US H11	(282110) 546H3 x C36	15,581	49.12	15.86	0.7	0.1	139	2.84	84.8	269
Y452H8	F82-546H3 x Y352	15,458	48.74	15.88	1.0	0.5	142	2.76	85.1	270
HH37	Holly	15,349	46.42	16.51	1.8	1.6	148	2.74	85.7	283
Y449H8	F82-546H3 x Y349	15,263	48.43	15.76	0.4	0.7	138	2.76	85.1	268
Y447H8	F82-546H3 x Y347	15,250	48.91	15.59	0.6	0.7	139	2.79	84.8	264
4905H8	F82-546H3 x 3218-21	15,227	48.13	15.82	0.4	0.5	144	2.78	85.0	269
Y448H8	F82-546H3 x Y348	15,182	47.21	16.09	2.4	0.7	135	2.89	84.7	272
4904H8	F82-546H3 x Y339H67	15,086	47.71	15.85	1.0	0.7	139	2.73	85.2	270
Y446H8	F82-546H3 x F82-46(C46)	14,993	46.55	16.11	0.1	1.1	132	2.75	85.4	275
4903H8	F82-546H3 x ER-YR Y246H53	14,984	47.50	15.79	0.9	0.4	135	2.78	85.0	268
E337H8	F78-546H3 x F81-37(C37)	14,891	47.51	15.71	0.4	0.2	137	2.73	85.1	267
Y453H8	F82-546H3 x Y353	14,863	46.40	16.03	0.7	3.4	135	2.86	84.8	272
Y441H8	F82-546H3 x Y341	14,781	46.32	15.94	1.2	0.5	141	2.63	85.8	273
Y439H8	F82-546H3 x Y339	14,384	44.08	16.35	0.8	0.4	140	2.75	85.6	280
Mean		15,164	47.42	16.00	0.8	1.0	139	2.77	85.2	272
LSD (.05)		749	1.70	NS	1.1	1.2	8	NS	NS	11
C. V. (%)		5.0	3.6	3.8	128.6	118.8	5.4	8.0	1.2	4.4
F value		1.7*	4.4**	1.6NS	2.4**	4.0**	2.0*	0.7NS	1.1NS	1.7*

[1/] 546H3 = C562CMS x C546. Y-numbers = MM, S^sS^s lines involved in virus yellows, Erwinia, and powdery mildew resistance improvement program.

Note: Powdery mildew totally controlled with Bayleton. BWYV incidence light to moderate. Root rot counted at harvest and probably due to Erwinia.

TEST 1685. SECOND EVALUATION OF C546H3 x MULTIGERM BREEDING LINES, SALINAS, CA, 1985

16 entries x 8 reps, RCB
2-row plots, 30 ft. long

Planted: February 4, 1985
Harvested: October 1-2, 1985

Variety	Description[1/]	Acre Yield Sugar Lbs	Acre Yield Beets Tons	Sucrose %	Bolting %	Root Rot %	Beets/ 100' Number	Non Sucrose SS %	Raw J. App. Purity %	Extract. Sugar Lbs/T
Y446H56	C309aa x F82-46(C46)	17,154	45.92	18.69	0.0	0.2	121	3.49	84.3	315
Y453H8	F82-546H3 x Y353	16,199	45.39	17.88	0.0	1.5	125	2.85	86.2	308
4905H8	F82-546H3 x 3218-21	16,184	46.25	17.47	0.0	0.2	130	2.77	86.3	301
Y448H8	F82-546H3 x Y348	15,846	46.01	17.25	0.3	0.5	130	2.84	85.8	296
Y439H8	F82-546H3 x Y339	15,831	44.39	17.82	0.0	0.7	122	2.91	85.9	306
Y449H8	F82-545H3 x Y349	15,771	45.69	17.29	0.0	0.5	129	2.97	85.3	295
Y441H8	F82-546H3 x Y341	15,506	45.36	17.08	0.0	0.8	128	3.03	84.9	290
Y452H8	F82-546H3 x Y352	15,383	44.79	17.18	0.3	0.5	128	2.92	85.4	293
Y447H8	F82-546H3 x Y347	15,210	44.68	17.03	0.0	0.2	130	2.92	85.3	290
E337H8	F78-546H3 x F81-37(C37)	15,208	44.67	16.99	0.0	0.0	129	3.00	85.0	289
HH37	Holly	15,172	44.12	17.18	0.0	0.2	127	2.70	86.4	296
Y431H8	F82-546H3 x Y331(C31/5)	15,088	44.91	16.72	0.3	0.0	122	2.99	84.7	283
US H11	(83381) C546H3 x C36	15,080	43.90	17.14	0.0	0.0	133	2.72	86.2	295
4904H8	F82-546H3 x Y339H67	15,035	44.99	16.69	0.2	0.6	131	2.73	85.9	286
4903H8	F82-546H3 x YR-ER Y246H53	14,737	44.30	16.58	0.0	0.3	124	2.79	85.6	283
Y446H8	F82-546H3 x F82-46	14,717	42.96	17.08	0.0	0.2	127	2.74	86.1	294
Mean		15,508	44.89	17.25	0.1	0.4	127	2.90	85.6	295
LSD (.05)		1,052	NS	0.75	0.3	0.7	7	0.28	1.0	13
C. V. (%)		6.9	5.2	4.40	402.4	185.7	5	9.6	1.2	4.5
F value		2.9**	1.1NS	3.8**	1.7*	2.3**	2.1*	3.8**	2.9**	3.4**

[1/] 546H3 = C562CMS x C546. Y-#'s = MM, S^sS^s lines being improved for disease resistance (virus yellows, curly top, Erwinia, powdery mildew, downy mildew, rust, etc.). Y246H53 (903), Y339H67 (904), 3218-21 (905) = MM, S^f, A:aa populations under development.

TEST 685. COMBINING ABILITY OF MM, YR GERMPLASM WITH C718H0, SALINAS, CA, 1985

24 varieties x 8 reps, RCB
1-row plots, 30 ft. long

Planted: January 14, 1985
Harvested: September 26, 1985

Variety	Description[1/]	Acre Yield Sugar	Acre Yield Beets	Sucrose	Bolting	Root Rot	Beets/ 100'	Non Sucrose SS	Raw J. App. Purity	Extract. Sugar
		Lbs	Tons	%	%	%	Number	%	%	Lbs/T
Y448H72	C718H0 x Y348	15,567	47.02	16.50	1.8	0.6	136	2.82	85.4	282
4904H72	C718H0 x Y339H67	15,132	46.02	16.42	0.0	1.3	128	2.79	85.5	280
Y449H72	C718H0 x Y349	15,080	44.77	16.83	0.0	0.6	136	2.80	85.7	288
4905H72	C718H0 x 3218-21	15,027	44.57	16.88	0.0	0.3	129	2.94	85.1	287
Y431H72	C718H0 x Y331(C31/5)	14,756	43.73	16.87	0.0	0.0	136	2.74	86.1	290
3747H72	C718H0 x 2747	14,756	45.12	16.41	0.3	1.6	126	2.77	85.6	280
Y452H72	C718H0 x Y352	14,743	44.74	16.48	0.0	2.1	136	2.79	85.5	281
Y446H72	C718H0 x F82-46	14,725	44.00	16.73	0.0	0.0	133	2.74	85.9	287
Y441H72	C718H0 x Y341	14,493	43.53	16.61	0.0	1.4	138	2.93	85.0	282
3902H72	C718H0 x Y254H53	14,365	44.32	16.21	1.0	0.0	124	2.84	85.1	275
Y453H72	C718H0 x Y353	14,311	41.67	17.21	0.3	3.6	117	2.86	85.8	295
Y447H72	C718H0 x Y347	14,280	43.29	16.48	1.0	1.0	126	2.77	85.6	282
Y446H56	C309aa x F82-46	14,222	39.10	18.20	0.0	0.0	124	3.46	84.1	305
E337H8	F78-546H3 x F81-37	14,129	42.79	16.50	0.0	0.3	133	2.95	84.8	279
Y446H31	F82-301CMS x F82-46	14,118	42.68	16.56	0.3	0.6	129	2.84	85.4	282
Y439H72	C718H0 x Y339	14,111	41.51	16.99	1.5	0.0	133	2.79	85.9	292
US H11	282110 546H3 x C36	14,107	41.95	16.82	1.4	0.0	143	2.96	85.0	286
HH37	Holly	14,095	40.74	17.33	1.1	0.8	143	2.86	85.9	297
Mono 1167	Hilleshog	13,991	39.60	17.66	0.5	1.1	142	2.96	85.6	302
Y446H8	F82-546H3 x F82-46	13,758	40.24	17.09	0.0	0.2	137	2.93	85.4	291

TEST 685. COMBINING ABILITY OF MM, YR GERMPLASM WITH C718H0, SALINAS, CA, 1985 (Cont'd)

24 varieties x 8 reps, RCB
1-row plots, 30 ft. long

Planted: January 14, 1985
Harvested: September 26, 1985

Variety	Description[1/]	Acre Yield Sugar	Acre Yield Beets	Sucrose	Bolting	Root Rot	Beets/ 100'	Non Sucrose SS	Raw J. App. Purity	Extract. Sugar
		Lbs	Tons	%	%	%	Number	%	%	Lbs/T
E337H72	C718H0 x F81-37	13,482	39.95	16.84	0.0	1.5	129	2.99	84.9	286
Y446H59	C308aa x F82-46	13,007	36.99	17.58	0.0	1.5	120	3.17	84.7	297
Y448H37	F83-306CMS x F82-46	12,980	38.62	16.85	0.0	1.3	124	3.13	84.4	284
Ritmo	Maribo	12,217	34.52	17.73	13.1	0.3	128	3.13	85.0	301
Mean		14,227	42.15	16.91	0.9	0.8	131	2.92	85.3	288
LSD (.05)		1,250	3.27	0.69	2.3	1.5	9	0.28	NS	13
C. V. (%)		8.9	7.80	4.10	247.2	185.3	7.5	9.70	1.5	4.7
F value		2.9**	6.5**	4.0**	10.4**	2.4**	4.0**	2.9**	NS	2.8**

[1/] The pollinators of these hybrids represent advancing germplasm lines in our improvement program. The Y-#'s are MM, S^sS^s lines being improved for combined resistance to virus yellows, curly top, bolting, Erwinia, and powdery mildew. Pollinatios 2747 (901), Y254H53 (902), Y339H67 (904), and 3218-21 (905) = MM, S^f, A:aa populations nearly equivalent to MM, S^sS^s lines that are being developed for use in breeding studies and population improvement. These populations should readily lend themselves to reciprocal recurrent selection and to S_1 progeny recurrent selection methods to improve the disease resistance and combining ability of pollinators. Ritmo and Mono 1167 are rhizomania tolerant hybrids from Europe.

Note: PM was controlled with Bayleton. Infection with BWYV was moderate. A low frequency of plants was infected with rhizomania in this and adjacent tests but probably had little influence on yield.

TEST 785. EVALUATION OF MONOGERM POPNS AND LINES, SALINAS, CA, 1985

32 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: January 14, 1985
Harvested: September 11-12, 1985

Variety	Description[1/]	Acre Yield		Sucrose	Bolting	Root Rot	Beets/ 100'	Non Sucrose SS	Raw J. App. Purity	Extract. Sugar
		Sugar Lbs	Beets Tons	%	%	%	Number	%	%	Lbs/T
KW 1132	Betaseed	14,767	41.01	17.99	5.8	3.7	132	2.7	86.8	312
Y446H74	0755-125aa x F82-46	14,676	44.86	16.41	0.7	0.3	123	2.8	85.3	279
Y446H56	C309aa x F82-46	14,528	40.56	17.91	0.0	0.6	114	3.4	84.0	300
HH37	Holly	14,417	41.92	17.22	0.9	1.7	142	3.0	84.8	292
Y446H75	0755-129aa x F82-46	14,330	41.55	17.31	2.1	0.6	122	3.1	84.5	292
Y446H8	F82-546H3 x F82-46	14,231	42.95	16.57	0.0	0.3	128	3.0	84.6	280
Y446H65	3217aa x F82-46	14,187	41.00	17.36	0.3	0.0	119	3.1	84.4	293
Y446H37	F83-306CMS x F82-46	14,164	42.98	16.51	0.0	0.6	133	3.0	84.2	278
Y446H62	3212aa x F82-46	14,033	42.31	16.64	0.0	0.0	121	2.9	84.8	282
Y446H82	3755Zaa x F82-46	13,999	39.54	17.74	0.3	0.0	123	3.1	84.9	301
Y446H57	0755-18aa x F82-46	13,891	41.14	16.88	0.0	0.2	133	2.9	85.0	287
Y446H88	3755Kaa x F82-46	13,882	42.19	16.48	1.6	1.0	126	3.1	84.1	277
Y446H58	0755-34aa x F82-46	13,871	41.52	16.71	0.0	0.0	125	2.7	85.9	287
Y446H52	3812aa x F82-46	13,857	42.41	16.31	0.0	0.0	122	2.9	84.7	276
US H11	(282110)546H3 x C36	13,854	42.76	16.23	0.5	0.0	140	3.0	84.3	273
E337H8	F78-546H3 x F81-37	13,840	41.71	16.61	0.6	0.0	130	3.0	84.6	281
Y446H83	3755aa x F82-46	13,802	40.77	16.99	0.0	0.6	126	3.1	84.3	286
Y346H3	C562H0 x F82-46	13,770	40.61	16.97	0.3	0.0	133	3.2	84.1	285
Y446H72	C718H0 x F82-46	13,765	42.56	16.16	0.0	0.3	126	2.9	84.7	274
Y446H31	F82-301CMS x F82-46	13,752	41.63	16.58	0.6	0.3	126	3.1	84.2	279

TEST 785. EVALUATION OF MONOGERM POPNS AND LINES, SALINAS, CA, 1985 (Cont'd)

32 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: January 14, 1985
Harvested: September 11-12, 1985

Variety	Description[1/]	Acre Yield Sugar Lbs	Acre Yield Beets Tons	Sucrose %	Bolting %	Root Rot %	Beets/ 100' Number	Non Sucrose SS %	Raw J. App. Purity %	Extract. Sugar Lbs/T
Y446H51	3811aa x F82-46	13,744	40.55	16.97	0.0	0.0	121	3.4	83.0	282
Y446H61	0755-112aa x F82-46	13,715	40.26	17.04	0.0	0.6	121	3.3	83.5	284
Y446H53	3813aa x F82-46	13,663	41.27	16.61	0.3	0.3	114	3.1	83.8	278
Y446H55	3755-22aa x F82-46	13,428	38.57	17.42	0.0	0.3	118	3.4	83.6	291
Y446H54	3814aa x F82-46	13,295	40.70	16.36	2.5	0.6	111	3.1	84.0	275
Y446H76	0755-133aa x F82-46	13,218	38.38	17.23	0.0	2.4	118	3.3	83.6	288
Y446H40	C303HO x F82-46	13,075	41.10	15.93	0.3	0.3	130	2.9	84.3	268
Y446H63	3214aa x F82-46	12,919	38.03	17.00	2.4	4.0	112	3.0	84.7	288
Y446H64	3216aa x F82-46	12,913	38.32	16.89	0.0	0.4	96	3.4	83.2	281
Y446H59	C308aa x F82-46	12,738	38.55	16.52	0.0	0.9	119	3.2	83.7	276
Y446H39	C302HO x F82-46	12,609	38.90	16.21	0.0	1.7	129	3.1	83.7	271
RITMO-1	MARIBO	12,393	35.88	17.34	12.2	1.6	130	3.3	84.0	291
Mean		13,729	40.83	16.85	1.0	0.7	124	3.1	84.4	284
LSD (.05)		1,032	2.95	0.68	2.2	1.4	11	0.2	1.1	12
C. V. (%)		7.6	7.30	4.10	230.9	187.6	9.1	9.4	1.4	4.3
F value		2.5**	3.0**	4.4**	8.5**	4.0**	5.2**	3.3**	3.4**	4.7**

[1/] HO = CMS. aa = genetic ms. 546H3 = C562CMS x C546. F82-46 = C46. F81-37 = C37. 0755-22 through 0755-133 and 3811 through 3814 = Increase of S_1 lines extracted from monogerm popn-755. 3755Z, 3755, and 3755K = various cycles of popn-755. 3212, 3214, 3216, 3217 = monogerm, S^f, A:aa popns.

Note: Powdery mildew completely controlled with Bayleton. BWYV incidence light to moderate. Root rot counted at harvest and probably due to Erwinia.

TEST 885. HYBRID EVALUATION OF POPULATIONS AND LINES, SALINAS, CA 1985

32 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: January 14, 1985
Harvested: September 16-17, 1985

Variety	Description[1/]	Acre Yield Sugar	Acre Yield Beets	Sucrose	Bolting	Root Rot	Beets/ 100'	Non Sucrose SS	Raw J. App. Purity	Extract. Sugar
		Lbs	Tons	%	%	%	Number	%	%	Lbs/T
E337H47	C306aa x F81-37	15,600	45.98	16.98	0.3	0.7	120	2.8	85.6	290
Y431H95	C796H0 x Y331	15,521	46.52	16.69	0.9	0.6	129	2.8	85.5	285
E337H31	F82-301CMS x F81-37	15,509	47.86	16.19	0.0	0.3	129	3.0	84.1	272
KW1132	Betaseed	15,453	43.43	17.81	7.5	2.4	131	2.7	86.6	308
Y431H37	F83-306CMS x Y331	15,393	46.22	16.65	0.0	0.3	129	2.9	84.8	282
Y446H21	C301H72 x F82-46	15,324	46.32	16.54	0.6	0.3	131	2.8	85.1	281
Y446H22	C546HL5 x F82-46	15,015	46.38	16.17	0.6	0.3	123	2.8	85.1	275
Y446H72	C718H0 x F82-46	14,996	46.12	16.27	0.0	0.6	129	2.8	85.3	277
Y446H62	3212aa x F82-46	14,929	45.30	16.41	0.0	0.3	121	2.7	85.4	280
4903H82	3755Zaa x ER-YR Y246H53	14,865	42.99	17.32	0.3	1.3	132	3.1	84.7	293
Y446H37	F83-306CMS x F82-46	14,846	45.36	16.38	0.0	1.6	124	2.9	84.7	277
4905H82	3755Zaa x 3218-21	14,838	43.56	17.06	0.3	0.0	131	2.8	85.7	292
Y439H31	F82-301CMS x Y339	14,713	43.53	16.88	4.9	0.3	129	3.0	84.6	285
4756H67	3747aa x 3755Z	14,652	44.48	16.49	0.9	0.3	125	3.0	84.3	278
US H11	(282110)546H3 x C36	14,637	45.07	16.23	1.5	0.0	138	2.8	84.9	275
HH37	Holly	14,637	44.06	16.63	0.5	2.0	141	2.7	85.7	285
E337H50	C303aa x F81-37	14,541	44.57	16.34	0.7	0.3	117	2.7	85.6	279
4904H82	3755Zaa x Y339H67	14,446	43.23	16.71	0.3	0.6	123	3.0	84.4	282
Y446H65	3217aa x F82-46	14,415	43.20	16.67	1.0	0.3	116	2.9	84.8	282
Y446H8	F82-546H3 x F82-46	14,291	43.19	16.54	0.0	0.3	130	2.8	85.1	281

TEST 885. HYBRID EVALUATION OF POPULATIONS AND LINES, SALINAS, CA 1985 (Cont'd)

32 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: January 14, 1985
Harvested: September 16-17, 1985

Variety	Description[1/]	Acre Yield Sugar	Acre Yield Beets	Sucrose	Bolting	Root Rot	Beets/ 100'	Non Sucrose SS	Raw J. App. Purity	Extract. Sugar
		Lbs	Tons	%	%	%	Number	%	%	Lbs/T
Y439H95	C796HO x Y339	14,289	41.96	17.08	0.9	0.3	128	3.0	85.1	290
Y446H82	3755Zaa x F82-46	14,263	41.94	17.01	0.0	0.3	129	3.0	84.7	288
Y446H31	F82-301CMS x F82-46	14,217	43.79	16.26	1.4	0.7	119	3.0	84.3	274
4790KH67	3747aa x 2790-S_1(SY)	14,179	44.33	15.99	0.3	1.3	125	3.0	84.2	269
4819H67	3747aa x C308	14,106	43.36	16.29	0.3	0.3	124	3.0	84.3	275
Y446H56	C309aa x F82-46	14,027	40.25	17.45	0.0	0.4	111	3.1	84.6	295
Y446H16	2755HO x F82-46	13,999	42.58	16.43	0.3	0.6	127	3.0	84.2	276
Y446H59	C308aa x F82-46	13,931	41.89	16.64	0.3	2.0	117	3.2	83.8	279
E337H8	F78-546H3 x F81-37	13,852	42.93	16.10	0.0	0.3	131	3.0	83.9	270
Y446H97	C796aa x F82-46	13,720	41.11	16.67	0.3	0.0	114	2.9	84.9	283
Y446H24	F83-306H72 x F82-46	13,618	42.71	15.93	0.4	1.2	127	2.8	84.6	269
Ritmo-4	Maribo	13,588	38.86	17.53	0.5	0.3	138	3.0	85.0	298
Mean		14,575	43.85	16.64	0.8	0.6	126	2.9	84.9	282
LSD (.05)		1,210	2.87	0.72	1.4	0.0	8	0.2	1.0	13
C. V. (%)		8.40	6.60	4.40	177.4	230.9	7.1	8.5	1.3	4.8
F value		1.8**	3.7**	3.1**	8.9**	1.3NS	4.8**	2.1**	2.6**	3.4**

[1/] HO = CMS. aa = genetic ms. 546H3 = C562CMS x C546. F82-46 = C46. F81-37 = C37. Y331 = C31/5. C301H72 = C718HO x C301. C546HL5 = C301 x C546. C306H72 = C718HO x C306. 2755, 3755Z, 3212, 3217, and 2790 = monogerm, S^f, A:aa popns. 3747, Y246H53, Y339H67, 3218-21 = multigerm, S^f, A:aa popns.

Note: See Test 785.

TEST 1785. EVALUATION OF COMMERCIAL, ADVANCED, AND EXPERIMENTAL HYBRIDS, SALINAS, CA, 1985

32 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: February 5, 1985
Harvested: September 30, 1985

Variety[1]	Description[2]			Acre Yield		Sucrose	Bolting	Root Rot	Beets/ 100'	Non Sucrose SS	Raw J. App. Purity	Extract. Sugar
	MS	T-O	♂	Sugar Lbs	Beets Tons	%	%	%	Number	%	%	Lbs/T
Commercial Hybrids												
SS-NB2	Spreckels			18,772	52.94	17.73	0.3	0.3	129	2.76	86.5	306
USH 11	C562CMS	C546	C36	17,356	52.80	16.44	0.0	0.0	130	2.72	85.8	282
Monodoro	Hilleshog			17,208	50.14	17.13	0.0	1.1	124	2.73	86.2	295
Monohikari	Japanese			16,919	45.71	18.49	7.3	0.0	114	2.30	88.9	328
KW1132	KW-Betaseed			16,770	46.57	17.96	1.4	2.0	107	2.56	87.5	314
Ultramono	Maribo			16,479	44.65	18.42	0.0	4.1	121	2.68	87.3	321
HH37	Holly			16,328	48.81	16.74	0.3	0.0	137	2.63	86.4	289
USC-3	Union			16,025	49.41	16.24	0.0	1.3	124	2.74	85.5	277
Ritmo-1	Maribo			15,262	44.28	17.23	0.8	3.1	112	2.96	85.3	294
Ritmo	Maribo			14,362	41.82	17.14	1.3	2.7	115	3.03	84.9	291
Advanced & Experimental Hybrids												
Y446H40	C303CMS		C46	18,008	55.42	16.23	0.0	0.0	126	2.63	86.0	279
Y446H37	C306CMS		C46	17,725	53.38	16.61	0.0	0.3	124	2.68	86.1	286
Y446H31	C301CMS		C46	17,383	52.33	16.59	0.0	0.0	116	2.96	84.8	281
Y446H8	C562CMS	C546	C46	16,600	49.67	16.70	0.0	0.0	125	2.62	86.4	288
Y446H72	C718CMS		C46	15,724	48.88	16.13	0.0	0.0	114	2.58	86.1	278
Y446H56	C309aa		C46	17,321	49.33	17.56	0.0	0.0	113	3.11	84.9	298
Y446H59	C308aa		C46	16,902	50.90	16.61	0.0	1.7	121	2.90	85.1	282
Y446H54	3814aa		C46	18,108	53.67	16.89	0.0	0.0	115	2.74	86.0	290
Y246H55-21	1755-21aa		C46	17,801	51.26	17.37	0.0	0.4	114	2.71	86.5	300
Y246H55-4	1755-4aa		C46	17,626	51.35	17.15	0.0	0.0	126	2.91	85.5	293

TEST 1785. EVALUATION OF COMMERCIAL, ADVANCED, AND EXPERIMENTAL HYBRIDS, SALINAS, CA, 1985 (Cont'd)

32 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: February 5, 1985
Harvested: September 30, 1985

Variety[1]	Description[2] MS	T-O	♂	Acre Yield Sugar Lbs	Beets Tons	Sucrose %	Bolting %	Root Rot %	Beets/ 100' Number	Non Sucrose SS %	Raw J. App. Purity %	Extract. Sugar Lbs/T
Advanced & Experimental Hybrids												
Y246H55-35	1755-35aa		C46	17,160	49.34	17.38	0.0	0.3	124	2.89	85.7	298
Y246H59-24	1742-24aa		C46	16,104	47.99	16.76	0.0	0.5	101	2.80	85.6	287
Y346H65-23	S_2-2216-23aa		C46	17,984	52.04	17.26	0.0	0.0	123	2.78	86.1	297
Y346H65-8	S_2-2216-8aa		C46	17,177	50.65	16.99	0.0	0.6	94	2.87	85.5	290
Y246H50-69	C779CMS	C790-69	C46	17,378	50.88	17.08	0.0	0.0	124	2.81	85.8	293
Y246H50-5	C779CMS	790-5	C46	17,269	50.80	16.98	0.0	0.3	122	2.76	86.0	292
Y246H50-75	C779CMS	790-75	C46	16,464	48.57	16.94	0.0	0.3	114	2.63	86.5	293
4903H82	3755Zaa		YR-903	18,281	54.16	16.89	0.0	0.3	125	2.76	85.9	290
Y439H16	2755CMS		Y339	17,856	52.13	17.13	0.3	0.6	130	2.75	86.2	295
4904H82	3755Zaa		Y339H67	17,796	52.26	17.01	0.0	0.3	114	2.91	85.4	290
Multigerm Lines												
Y452Z	C92(ER-YR-PMR Y252)			16,725	48.79	17.14	0.3	0.0	118	3.09	84.7	290
Y439	Inc. Y339			15,715	44.86	17.51	0.7	0.0	114	3.11	84.9	297
Mean				17,018	49.87	17.08	0.4	0.6	119	2.78	85.9	293
LSD (.05)				1,433	3.51	0.69	1.0	1.5	12	0.22	0.9	13
C. V. (%)				8.5	7.1	4.10	254.6	242.6	10	7.9	1.1	4.5
F value				3.4**	6.3**	5.1**	13.2**	3.4**	3.9**	5.2**	6.4**	5.9**

1/ Commercial hybrids not necessarily adapted to California but used to determine relative performances.

2/ Y452Z (C92) and Y439 = MM, S^sS^s yellows resistant lines. 903, Y339H67 (904) = MM, S^f, A:aa populations. 3755Z, 2755CMS = mm, S^f, A:aa population. 3814, 1755-4,-21,-35 = cognates from popn-755. 1742-24 = S_1 line from popn-742. 2216-23,-8, = S_2 lines from popn-216 (766). C790-69, 790-5, 790-75 = S_3 lines from popn-790.

Note: PM controlled with Bayleton. Root rot counted at harvest and probably caused by Erwinia. BWYV infection late but moderately severe. Mild and late infection with rhizomania observed at harvest in some roots.

TEST 1585. EVALUATION OF Y246H55, Y246H57, AND Y246H59 S_1-TX PROGENIES, SALINAS, CA, 1985

16 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: February 4, 1985
Harvested: October 4, 1985

Variety[1/]	Description[2/]	Acre Yield Sugar	Acre Yield Beets	Sucrose	Root Rot	Beets/ 100'	Non Sucrose SS	Raw J. App. Purity	Extract. Sugar
		Lbs	Tons	%	%	Number	%	%	Lbs/T
Checks									
US H11	C546H3 x C36(83381)	16,488	46.45	17.74	0.3	133	3.22	84.6	300
Y446H8	F82-546H3 x F82-46	16,496	46.33	17.81	0.0	128	3.24	84.6	301
Y246H4	F67-563H0 x Y146	16,386	45.61	17.97	0.0	136	3.21	84.8	304
Y446H72	C718H0 x F82-46	15,738	45.92	17.11	0.0	126	3.06	84.8	290
Y446H31	F82-301CMS x F82-46	16,213	45.88	17.69	0.0	130	3.33	84.1	297
Y446H56	C309aa x F82-46	17,398	45.25	19.24	0.0	129	3.86	83.3	320
Y446H59	C308aa x F82-46	15,941	44.20	18.03	0.6	124	3.51	83.7	301
Y446H82	3755Zaa x F82-46	16,742	45.21	18.53	0.0	132	3.41	84.4	313
S_1-TX From 1183 &1884									
Y246H55-4	1755-4aa x Y146	16,808	46.31	18.17	0.0	134	3.34	84.5	307
Y246H55-21	1755-21aa x Y146	16,758	46.32	18.09	0.3	127	3.36	84.3	305
Y246H55-35	1755-35aa x Y146	15,628	42.63	18.36	0.3	135	3.44	84.1	309
S_1-TX From 1283 & 1884									
Y246H57-5	1757-5aa x Y146	17,011	47.76	17.81	0.3	124	3.24	84.6	301
Y246H57-25	1757-25aa x Y146	16,673	46.56	17.90	0.0	127	3.44	83.9	300
Y246H57-35	1757-35aa x Y146	16,432	44.94	18.28	0.0	126	3.41	84.3	308
Y246H57-29	1757-29aa x Y146	15,859	44.13	17.95	0.0	130	3.32	84.4	303
S_1-TX From 1383 & 1884									
Y246H59-24	1742-24aa x Y146	17,770	49.24	18.06	0.3	132	3.33	84.4	304
Mean		16,521	45.80	18.05	0.1	130	3.36	84.3	304
LSD (.05)		974	2.76	0.51	NS	NS	0.24	0.89	9
C. V. (%)		6.0	6.1	2.8	424.5	6.8	7.2	1.1	3
F value		2.8**	2.4**	6.2**	0.9NS	1.4NS	4.2**	1.7*	4.0**

1/ S_1-TX progenies were originally evaluated in 1983 in tests 1183, 1283, & 1383 (56, 32, 40 progenies x 4 reps.). 26 were retested in 1984 in test 1884. From 1884, 8 entries were evaluated in 1985. Superior S_1's will be increased, topcrossed, and evaluated for disease resistance, GCA, adaptation, bolting, & seed traits.
2/ F82-46 and Y146 = C46. 3755Z = C5 of popn-755 by mass selection for disease resistance and % sucrose. C301, C308, and C309 = cognates from popn-755 (C2 by MS) released previously. 1742-#'s, 1755-#'s, and 1757-#'s = S_1 lines extracted from mm, Sf, A:aa populations 742 (C2 by MS), 755 (C3 by MS), and 757 (C2 by MS). Genetic ms (aa) plants within each S_1 family were topcrossed to C46 to produce the S_1-TX's.

TEST 2885. REEVALUATION OF Y345H97 S_1-TESTCROSSES, SALINAS, CA, 1985

16 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: April 19, 1985
Harvested: October 23-24, 1985

Variety	Description[1/]	Acre Yield Sugar Lbs	Acre Yield Beets Tons	Sucrose %	Root Rot %	Beets/ 100' Number	Non Sucrose SS %	Raw J. App. Purity %	Extract. Sugar Lbs/T	Powdery Mildew Rating
Checks										
US H11	546H3 x C36 (482397)	10,277	31.10	16.51	0.0	130	3.02	84.5	279	6.8
Y346H8	F78-546H3 x F82-46	10,572	30.53	17.31	0.3	119	3.08	84.8	294	4.8
Y346H96	1796aa x F82-46	10,130	30.39	16.66	0.4	127	2.85	85.4	284	6.1
Y439H95	C796H0 x Y339	11,023	31.59	17.43	0.0	126	3.09	84.9	296	5.5
S_1-Testcrosses (High CA)										
Y346H97-114	2796-114aa x F82-46	11,452	33.31	17.19	0.0	126	3.14	84.5	290	6.0
Y346H97-15	2796-15aa x F82-46	10,979	31.78	17.27	0.0	117	2.90	85.6	295	6.3
Y346H97-43	2796-43aa x F82-46	10,949	31.56	17.36	0.0	116	2.83	85.9	298	5.7
Y346H97-123	2796-123aa x F82-46	10,862	31.65	17.16	0.0	104	2.81	85.9	294	6.0
Y346H97-6	2796-6aa x F82-46	10,821	30.45	17.76	0.0	119	3.16	84.8	301	6.6
Y346H97-22	2796-22aa x F82-46	10,693	31.34	17.04	0.5	89	2.96	85.2	290	6.3
Y346H97-117	2796-117aa x F82-46	10,570	31.06	16.98	0.4	119	3.12	84.5	286	7.0
Y346H97-85	2796-85aa x F82-46	10,358	29.84	17.35	0.0	121	2.89	85.7	297	6.7
Y346H97-42	2796-42aa x F82-46	10,327	30.58	16.89	0.8	112	3.01	84.8	286	6.9
Y346H97-28	2796-28aa x F82-46	10,112	28.96	17.48	0.0	119	3.05	85.1	297	6.8
S_1-Testcrosses (Low CA)										
Y346H97-98	2796-98aa x F82-46	10,109	31.63	15.99	0.0	100	2.98	84.2	269	5.8
Y346H97-37	2796-37aa x F82-46	9,029	26.98	16.71	0.0	101	3.05	84.5	282	6.0
Mean		10,516	30.80	17.07	0.1	115	3.00	85.0	290	6.2
LSD (.05)		760	2.00	0.35	NS	9	0.22	1.0	8	0.8
C. V. (%)		7.3	6.6	2.1	424.5	7.6	7.4	1.2	2.6	12.4
F value		4.2**	3.9**	12.2**	1.3NS	13.4**	2.1*	2.4**	9.7**	4.6**

1/ See pages A21-22, 1984 Report. On the basis of progeny test 2184 in 1984, high and low performing (CA) S_1-TX progenies of Y346H97 were reevaluated. 2796-#'s are S_1 progenies extracted from popn-C796 and top-crossed to C46. C796-22 = increase of 2796-22. 1796 and 3796 are similar to C796. C796 = mm, S^f, A:aa, VYR, CTR popn derived from crosses among C17, C04 and CTR monogerm inbreds.

Note: Moderate PM infection before application of Bayleton.

TEST 1885. EVALUATION OF Y446H31 TESTCROSSES, SALINAS, CA, 1985

32 entries x 7 reps, RCB
1-row plots, 30 ft. long

Planted: February 5, 1985
Harvested: October 7-8, 1985

Variety	Description[1/]	Acre Yield		Sucrose	Root Rot	Beets/ 100'
		Sugar Lbs	Beets Tons	%	%	No.
Checks						
Y446H8	F82-546H3 x F82-46	16,314	48.02	17.01	0.0	124
Y346H3	C562H0 x F82-46	14,992	45.89	16.31	0.3	109
Y446H31	F82-301CMS x F82-46	16,572	49.40	16.75	0.3	115
Y446H56	C309aa x F82-46	18,207	50.82	17.90	0.0	112
Y446H59	C308aa x F82-46	16,832	49.30	17.06	0.8	118
Y446H72	C718H0 x F82-46	16,153	50.98	15.79	0.0	112
Y446H82	3755Zaa x F82-46	16,591	47.72	17.41	0.0	117
Y446H86	2755Daa x F82-46	18,231	53.87	16.96	0.4	119
S_1-Testcrosses						
Y446H81-47	3755D-47aa x F82-46	18,643	56.04	16.66	0.4	117
Y446H81-121	3755D-121aa x F82-46	17,748	54.32	16.33	0.0	124
Y446H81-138	3755D-138aa x F82-46	17,646	50.92	17.35	3.4	109
Y446H81-4	3755D-4aa x F82-46	17,632	51.04	17.24	0.3	125
Y446H81-65	3755D-65aa x F82-46	17,491	51.32	17.08	2.4	115
Y446H81-42	3755D-42aa x F82-46	17,452	50.59	17.28	0.4	118
Y446H81-69	3755D-69aa x F82-46	17,450	52.63	16.57	0.3	120
Y446H81-132	3755D-132aa x F82-46	17,267	51.54	16.75	0.4	120
Y446H81-57	3755D-57aa x F82-46	17,150	51.84	16.51	0.0	119
Y446H81-101	3755D-101aa x F82-46	16,837	50.28	16.80	4.3	112
Y446H81-63	3755D-63aa x F82-46	16,817	49.60	16.94	0.0	127
Y446H81-84	3755D-84aa x F82-46	16,743	52.75	15.86	0.0	125

TEST 1885. EVALUATION OF Y446H81 TESTCROSSES, SALINAS, CA, 1985 (Cont'd)

32 entries x 7 reps, RCB
1-row plots, 30 ft. long

Planted: February 5, 1985
Harvested: October 7-8, 1985

Variety	Description[1/]	Acre Yield		Sucrose	Root Rot	Beets/ 100'
		Sugar	Beets			
		Lbs	Tons	%	%	No.
Y446H81-52	3755D-52aa x F82-46	16,702	50.66	16.54	0.0	120
Y446H81-120	3755D-120aa x F82-46	16,573	48.85	16.97	0.3	127
Y446H81-34	3755D-34aa x F82-46	16,498	50.75	16.25	0.3	110
Y446H81-23	3755D-23aa x F82-46	16,449	49.93	16.47	0.8	112
Y446H81-75	3755D-75aa x F82-46	16,424	48.28	16.99	0.0	121
Y446H81-10	3755D-10aa x F82-46	16,395	49.49	16.56	2.5	107
Y446H81-136	3755D-136aa x F82-46	16,353	46.85	17.44	0.5	119
Y446H81-139	3755D-139aa x F82-46	16,098	47.71	16.88	0.5	113
Y446H81-115	3755D-115aa x F82-46	15,983	49.30	16.25	0.7	118
Y446H81-8	3755D-8aa x F82-46	15,792	46.63	16.91	0.3	125
Y446H81-140	3755D-140aa x F82-46	15,413	46.95	16.44	0.7	107
Y446H81-36	3755D-36aa x F82-46	15,333	48.37	15.84	0.3	108
Mean		16,774	50.08	16.75	0.6	117
LSD (.05)		1,629	4.15	0.75	1.7	12
C. V. (%)		9.2	7.90	4.20	243.9	10.3
F value		2.1**	2.5**	3.3**	2.8**	1.7**

[1/] 2755D and 3755Z = advanced popns of 755, a mm, S^f, A:aa source. Lines C301, C308, and C309 previously extracted from popn-755. 3755D-#'s = S_1 progeny families extracted from cycle 1 (S_1-TX) of popn-755. Genetic ms (aa) segregates in these lines were top crossed to C46. Only S_1 families that appeared to be T-O or near-T-O in gh tests were included. Best S_1's will be increased and reevaluated in future tests for disease reaction and combining ability.

Note: Moderate infection with BWYV. Powdery mildew controlled with Bayleton. Rep 1 was deleted because of poor stands.

TEST 2785. REEVALUATION OF Y346H62 AND Y345H65 S_2-TESTCROSSES, SALINAS, CA, 1985

16 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: April 19, 1985
Harvested: October 23, 1985

Variety	Description[1/]	Acre Yield Sugar Lbs	Acre Yield Beets Tons	Sucrose %	Root Rot %	Beets/ 100' Number	Non Sucrose SS %	Raw J. App. Purity %	Extract. Sugar Lbs/T	Powdery Mildew Rating
Checks										
US H11	546H3 x C36 (482397)	10,349	30.16	17.16	0.0	131	2.83	85.9	294	8.1
Y346H8	F78-546H3 x F82-46	10,503	29.75	17.67	0.0	119	3.09	85.1	300	6.6
Y346H64	1216aa x F82-46	11,472	32.78	17.48	0.4	119	2.80	86.1	301	5.9
Y446H65	3217aa x F82-46	11,926	33.90	17.59	0.0	124	2.96	85.5	301	6.0
S_2-Testcrosses										
Y346H65-14	2216-14aa x F82-46	12,259	35.98	17.04	0.4	117	2.64	86.5	295	5.2
Y346H65-46	2216-46aa x F82-46	12,215	34.16	17.89	0.0	126	3.06	85.4	305	5.2
Y346H65-54	2216-54aa x F82-46	12,119	35.43	17.11	0.0	118	2.83	85.8	293	5.5
Y346H65-38	2216-38aa x F82-46	11,453	32.61	17.58	0.4	100	2.71	86.6	304	4.8
Y346H62-24	2214-24aa x F82-46	11,325	31.82	17.81	0.0	115	2.98	85.6	305	7.4
Y346H65-23	2216-23aa x F82-46	11,250	31.45	17.88	0.0	128	3.08	85.3	305	5.9
Y346H65-62	2216-62aa x F82-46	11,215	32.26	17.40	0.0	125	3.01	85.2	296	6.5
Y346H65-61	2216-61aa x F82-46	11,208	32.55	17.22	0.0	120	3.04	85.0	292	5.4
Y346H62-30	2214-30aa x F82-46	11,111	31.78	17.49	0.0	116	2.96	85.5	299	6.8
Y346H62-33	2214-33aa x F82-46	11,098	31.91	17.39	0.0	126	2.98	85.3	296	6.8
Y346H65-44	2216-44aa x F82-46	10,514	29.39	17.90	0.3	122	2.94	85.8	307	5.9
Y346H62-37	2214-37aa x F82-46	10,208	28.20	18.10	0.0	112	3.19	85.0	307	7.0
Mean		11,264	32.13	17.54	0.1	120	2.94	85.6	301	6.2
LSD (.05)		760	1.99	0.39	NS	8	0.24	1.0	8	0.7
C. V. (%)		6.8	6.3	2.3	574.8	6.9	8.2	1.2	2.8	12.3
F value		5.7**	8.8**	5.2**	0.8NS	6.6**	2.9**	1.9**	3.3**	11.1**

[1/] See pages A19-21, 1984 Report. On the basis of Test 684 in 1984, S_2-TX progenies were selected for reevaluation. Lines 2216-# and 2214-# are S_2 progenies from popn-766 and popn-764. 1216 and 3217 are different cycles of popn-766.

Note: Moderate PM infection before application of Bayleton.

TEST 2085. PERFORMANCE OF POPULATION HYBRIDS, SALINAS, CA, 1985

16 entries x 7 reps, RCB
1-row plots, 30 ft. long

Planted: February 5, 1985
Harvested: September 27, 1985

Variety	Description[1/]	Acre Yield		Sucrose	Bolting	Root Rot
		Sugar	Beets			
		Lbs	Tons	%	No.	No.
4903H82	3755Zaa x ER-YR Y246H53	17,913	49.00	18.29	0.0	0.1
Y446H65	3217aa x F82-46	17,897	50.21	17.80	0.0	0.1
Y446H62	3212aa x F82-46	17,828	51.24	17.41	0.0	0.1
KW1132	KW-Betaseed	17,301	47.01	18.42	0.4	2.0
US H11	C546H3 x C36 (83381)	17,282	49.96	17.29	0.0	0.1
4904H82	3755Zaa x Y339H67	17,189	48.84	17.62	0.0	0.1
E337H55	2755aa x F81-37	16,943	48.08	17.61	0.0	0.1
4756H68	3902aa x 3755Z	16,943	47.09	18.01	0.0	0.1
Y446H8	F82-546H3 x F82-46	16,855	47.78	17.62	0.0	0.0
Y446H82	3755Zaa x F82-46	16,792	46.99	17.84	0.0	0.1
3902H55	2755aa x Y254H53	16,764	47.42	17.67	0.0	0.2
3747H55	2755aa x 2747	16,752	49.32	16.99	0.0	0.0
Y431H95	C796H0 x Y331	16,702	48.47	17.21	0.0	0.1
4905H82	3755Zaa x 3218-21	16,691	48.37	17.23	0.0	0.0
4767H68	3902aa x 3217	16,657	48.52	17.16	0.1	0.1
Y439H95	C796H0 x Y339	16,499	46.40	17.79	0.0	0.1
Mean		17,063	48.42	17.62	0.0	0.2
LSD (.05)		NS	NS	0.58	0.2	0.5
C. V. (%)		9.00	7.90	3.10	451.4	190.2
F value		0.6NS	0.9NS	3.8**	3.3**	7.5**

[1/] 3755Z, 2755, 3212, 3217, & C796 = mm, S^f, A:aa popns. 2747 (901), Y254H53 (902), 3902, Y246H53 (903), Y339H67 (904), & 3218-21 (905) = MM, S^f, A:aa popns.

Note: Test 2085 was near the BWYV inoculated tests and developed moderate infection with BWYV. Rep. 1 was deleted because of poor stands.

TEST 1485. GCA OF S_3 LINES FROM POPN-790 PRODUCED BY SINGLE-SEED DESCENT, SALINAS, CA, 1985

16 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: February 4, 1985
Harvested: October 3, 1985

Variety[1/]	Description[2/]			Acre Yield		Sucrose	Root Rot	Beets/ 100'	Non Sucrose SS	Raw J. App. Purity	Extract Sugar
	CMS	T-O	♂	Sugar Lbs	Beets Tons	%	%	Number	%	%	Lbs/T
Checks											
Y446H8	C562	C546	C46	17,174	47.43	18.16	0.0	129	3.34	84.4	306
Y246H26	C779		C46	17,133	47.77	17.96	0.0	127	3.12	85.2	306
High SY and/or %S											
Y246H50-69	C779	790-69	C46	18,326	49.51	18.51	0.3	135	3.27	85.0	314
Y246H50-94	C779	790-94	C46	18,211	50.73	18.01	0.3	134	3.32	84.4	304
Y246H50-33	C779	790-33	C46	18,106	50.89	17.79	0.0	134	3.21	84.7	301
Y246H50-75	C779	790-75	C46	18,017	48.25	18.67	1.0	122	3.11	85.7	320
Y246H50-16	C779	790-16	C46	17,811	50.83	17.59	0.3	131	3.13	84.9	298
Y246H50-25	C779	790-25	C46	17,765	48.90	18.25	0.6	125	3.30	84.7	309
Y246H50-92	C779	790-92	C46	17,730	50.55	17.58	0.3	134	3.01	85.4	300
Y246H50-46	C779	790-46	C46	17,427	48.67	17.93	0.3	131	3.16	85.0	305
Y246H50-88	C779	790-88	C46	17,228	49.37	17.49	0.4	129	3.17	84.6	296
Y246H50-5	C779	790-5	C46	17,065	46.93	18.24	0.0	129	3.11	85.4	311
Low Sugar Yield											
Y246H50-34	C779	790-34	C46	17,302	47.86	18.07	0.7	132	3.03	85.6	309
Y246H50-97	C779	790-97	C46	16,962	47.55	17.84	1.1	125	3.09	85.3	304
Y246H50-21	C779	790-21	C46	16,959	48.13	17.64	0.0	125	3.20	84.6	298
Y246H50-62	C779	790-62	C46	16,752	45.68	18.38	0.7	134	3.44	84.2	309
Mean				17,498	48.69	18.01	0.4	130	3.19	84.9	306
LSD (.05)				909	2.56	0.44	NS	9	0.24	0.9	9
C. V. (%)				5.2	5.3	2.5	263.1	6.6	7.5	1.1	3
F value				2.4**	2.8**	5.0**	1.08NS	1.8*	2.0*	1.8*	4.4**

1/See test 2985 and pages A14-16 & A51-53 in 1984 Report. On the basis of previous tests (1083, 2084, 2884), hybrids were categorized as high sugar yield and/or high % sucrose entries or low sugar yield entries.
2/790-69 = C790-69. 790-25 = C790-25. The 790's are S_3 lines derived randomly from popn-790 by SSD. 3-way hybrids were used to estimate genetic variability for GCA within popn-790. Hybrids with S_3-790-69 has consistentely given high SY and with S_3-790-21 low SY indicating true genetic differences for GCA occurred within this set of lines and for popn-790.
Note: PM controlled with Bayleton.

TEST 2985. GCA OF S_3 LINES PRODUCED BY SINGLE-SEED DESCENT, SALINAS, CA, 1985

8 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: April 19, 1985
Harvested: October 17, 1985

Variety[1]	Description[2]			Acre Yield		Sucrose	Root Rot	Beets/ 100'	Non Sucrose SS	Raw J. App. Purity	Extract Sugar
	CMS	T-O	♂	Sugar Lbs	Beets Tons	%	%	Number	%	%	Lbs/T
Checks											
Y446H8	C562	C546	C46	10,302	30.04	17.15	0.3	117	2.64	86.6	297
Y246H26	C779		C46	11,014	32.24	17.09	0.0	129	2.47	87.3	298
High Sugar Yield or High % Sugar											
Y246H50-69	C779	790-69	C46	11,166	31.38	17.79	0.3	126	2.59	87.3	310
Y246H50-75	C779	790-75	C46	11,028	31.36	17.59	0.0	116	2.39	88.0	309
Y246H50-25	C779	790-25	C46	10,793	31.11	17.35	1.4	116	2.54	87.2	302
Y246H50-5	C779	790-5	C46	10,615	30.01	17.69	0.7	116	2.71	86.7	306
Low Sugar Yield											
Y246H50-21	C779	790-21	C46	10,678	31.05	17.21	1.1	112	2.58	86.9	299
Y246H50-34	C779	790-34	C46	10,102	29.42	17.14	0.3	114	2.49	87.2	299
Mean				10,712	30.83	17.38	0.5	119	2.55	87.2	303
LSD (.05)				696	NS	0.33	NS	8	NS	NS	7
C. V. (%)				6.5	6.30	1.90	228.7	7	9.40	1.2	2.4
F value				2.3*	1.8NS	5.4**	1.5NS	3.7**	1.4NS	1.3NS	4.4**

[1] See Test 1485 and pages A14-16 & A51-53 in 1984 Report. On the basis of tests 1083, 2084, and 2884 and and seed availabiltiy, 6 hybrids were retested. These 6 hybrids were categorized by their previous performance as high sugar yield or high % sugar entries or as low sugar yield entries.

[2] 790-69 = C790-69. 790-25 = C790-25.

Note: Plants had moderate PM infection until treated with Bayleton in August.

TEST 1285-1. S_1 PROGENY RECURRENT SELECTION: PERFORMANCE OF C0:C1:C2:C3 SYNTHETICS OF POPN-790
SALINAS, CA, 1985

8 entries x 8 reps, RCB
1-row plots, 30 ft. long

Planted: January 14, 1985
Harvested: September 20, 1985

Variety	Cycle[1/]	Description[3/]	Acre Yield[2/] Sugar Actual	Sugar Change	Beets Actual	Beets Change	Sucrose Actual	Sucrose Change	Root Rot	Beets/ 100'
			Lbs	%	Tons	%	%	%	%	No.
1790D	C2-Syn 1	9790-S_1(SY)aa x A	13,547	16.8	38.70	14.6	17.52	2.0	1.3	131
4790K	C3-Syn 1	2790-S_1(SY)aa x A	13,281	14.5	37.95	12.4	17.51	2.0	2.7	135
4790J	C2-Syn 2	2790-S_1(Check)aa x A	13,170	13.6	37.67	11.6	17.52	2.0	2.1	133
2790	C2(S_1 + BP)	1790aa x A	12,936	11.5	36.63	8.5	17.67	2.8	1.6	124
1790C	C1-Syn 2	9790-S_1(Check)aa x A	12,744	9.9	37.08	9.9	17.21	0.2	2.1	135
7790D	C1-Syn 1	5790-SY(S_1)aa x A	12,541	8.1	36.31	7.6	17.26	0.5	1.0	117
7790C	C0-Syn 1	5790-C0(S_1)aa x A	11,597	0.0	33.76	0.0	17.18	0.0	2.4	122
4790	C3(MS)	ER-YR 9790(A,aa)	11,220	-3.2	31.86	-5.6	17.61	2.5	0.3	131
Mean			12,630		36.25		17.43		1.7	129
LSD (.05)			1,052	8.3	2.97	8.2	NS	NS	NS	7
C. V. (%)			8.3		8.20		3.20		116.4	5.4
F value			4.9**		4.9**		0.9NS		1.3NS	7.7**

1/ S_1 progenies were initially derived from monogerm, self-fertile, A:aa popn-790. Three cycles of S_1 progeny recurrent selection with 16 to 20% selection differential have been completed. C0, C1, C2, and C3 were tested in equivalent phases after the first synthesis from the S_1 progenies. The second synthesis (syn 2) of cycles 1 and 2 were also evaluated. C2(S_1 + BP) represents 1 cycle of bulk-population selection following the first cycle of S_1-progeny selection. C3(MS) represents the third cycle of mass selection from the original popn-790. The C3(MS) entry was produced from both selfed (A_) and sibbed (aa x A_) mother root selections.

2/ C0-Syn 1 was used as the check to calculate % change.

3/ C790-No.'s C790-2,-41,-42,-55,-65, & -68 released in 1984 were six of the sixteen S_1 progeny families used to produce C3-Syn 1.

TEST 1285-2. S_1 PROGENY RECURRENT SELECTION: PERFORMANCE OF C0:C1:C2:C3 SYNTHETICS OF POPN-790
SALINAS, CA, 1985

8 entries x 8 reps, RCB
1-row plot, 30 ft. long

Planted: April 19, 1985
Harvested: October 29, 1985

Variety	Cycle[1]	Description[3]	Acre Yield[2] Sugar Actual	Sugar Change	Beets Actual	Beets Change	Sucrose Actual	Sucrose Change	Root Rot	Beets/ 100'
			Lbs	%	Tons	%	%	%	%	No.
4790K	C3-Syn 1	2790-S_1(SY)aa x A	8,110	18.0	24.52	13.5	16.53	4.2	3.0	118
2790	C2(S_1 + BP)	1790aa x A	7,983	16.2	24.45	13.2	16.34	3.0	0.0	112
1790D	C2-Syn 1	9790-S_1(SY)aa x A	7,919	15.3	24.89	15.2	15.83	-0.2	0.3	119
1790C	C1-Syn 2	9790-S_1(Check)aa x A	7,821	13.8	24.80	14.8	15.72	-0.9	0.6	121
4790J	C2-Syn 2	2790-S_1(Check)aa x A	7,721	12.4	23.79	10.2	16.20	2.1	1.6	115
4790	C3(MS)	ER-YR 9790(A,aa)	7,611	10.8	23.04	6.6	16.52	4.2	0.0	113
7790D	C1-Syn 1	5790-SY(S_1)aa x A	7,280	6.0	22.77	5.4	15.98	0.7	0.0	108
7790C	C0-Syn 1	5790-C0(S_1)aa x A	6,871	0.0	21.61	0.0	15.86	0.0	1.5	105
Mean			7,664		23.73		16.12		0.9	114
LSD (.05)			800	10.4	2.06	8.7	NS	NS	1.7	9
C. V. (%)			10.4		8.60		4.40		191.5	7.6
F value			2.1*		2.6*		1.6NS		3.1**	3.3**

[1], [2], [3] See footnotes for Test 1285-1.

TEST 1085-1. PERFORMANCE AND GCA OF CO:C1 SYNTHETICS J, K, L, & M OF POPN-755, SALINAS, CA, 1985

4 popns x 2 trtmts x 8reps., split-plot
1-row plots, 30 ft. long

Planted: January 14, 1985
Harvested: September 19, 1985

Variety	Description[1/]	Acre Yield: Sugar Actual (Lbs)	Sugar Change (%)	Beet Actual (Tons)	Beet Change (%)	Sucrose Actual (%)	Sucrose Change (%)	Bolters (%)	Root Rot (%)	Beets/ 100' (Number)
Y446H89	3755Laa(LIYR) x F82-46	14,339	7.1	42.56	8.2	16.84	-1.3	0.3	0.0	128
Y446H88	3755Kaa(SY) x F82-46	14,192	5.9	41.48	5.3	17.11	0.3	1.2	0.3	136
Y446H90	3755Maa(LIYS) x F82-46	14,015	4.4	40.84	3.6	17.18	0.7	0.3	0.9	127
Y446H87	3755Jaa(CO) x F82-46	13,478	0.0	39.52	0.0	17.06	0.0	0.3	0.3	128
3755L	0755-S_1(LIYR)aa x A	12,667	4.4	39.28	5.9	16.10	-1.4	10.8	0.3	135
3755K	0755-S_1(SY)aa x A	12,194	0.5	38.08	2.7	16.02	-1.9	10.3	2.2	130
3755J	0755-S_1(CO)aa x A	12,136	0.0	37.08	0.0	16.33	0.0	6.8	1.8	134
3755M	0755-S_1(LIYS)aa x A	11,558	-4.8	35.06	-5.4	16.49	1.0	4.7	0.6	136
Mean		13,072		39.24		16.64		4.3	0.8	132
LSD (.05)		920	7.0	1.89	4.8	0.73	4.4	3.3	NS	5
C. V. (%)		7		4.80		4.40		76.1	163.6	4.3
F value for varieties		3.2*		10.2**		1.0NS		3.4*	2.4NS	0.4NS
F value for popns vs hybrids		23.7**		31.1**		8.2*		130.2**	3.9NS	4.0NS
F value for variety x treatments		1.5NS		2.8NS		0.3NS		2.5NS	2.7NS	6.6**

1/ SY = sugar yield. LIYR & LIYS = divergent selections for SY under LIY conditions. CO = unselected check synthetic from recombined S_1 families. 0755 = S^f, mm, A:aa popns. In 1981, 84 S_1 families from popn-9755 were topcrossed to C37 and evaluated in incomplete block trials at Brawley and Salinas. At Salinas 3 reps were grown and at Brawley, results were based upon a single rep. In both locations, 7 S_1-TX entries plus 1 check were maintained as sets and selection was based upon the best line(s) within each set. At Brawley, severe LIYV infection occurred in the 1982 evaluation trial. Based upon the SY performance of the S_1-TX hybrids, S_1 families were selected and recombined. 3755J = CO or unselected check produced by recombining all 84 S_1 families. 3755K = C1 synthetic based upon 20% selection for SY. 3755L & 3755M = divergent selections for SY based only upon the single rep trial at Brawley. The variety hybrids Y446H87, etc., were produced in 1984 by topcrossing the male sterile (aa) plants in 755 synthetics with C46. Also see tests B184 & B685 from Imperial Valley trials and 884-1,-2 from Salinas.

TEST 1085-2. PERFORMANCE AND GCA OF CO:C1 SYNTHETICS J, K, L, & M OF POPN-755, SALINAS, CA, 1985

4 popns x 2 trtmts x 8 reps., split-plot
1-row plots, 30 ft. long

Planted: April 19, 1985
Harvested: October 29, 1985

Variety	Description[1/]	Acre Yield: Sugar Actual	Acre Yield: Sugar Change	Acre Yield: Beets Actual	Acre Yield: Beets Change	Sucrose Actual	Sucrose Change	Root Rot	Beets/ 100'	Mean Powd. Mildew
		Lbs	%	Tons	%	%	%	%	Number	Rating
Y446H89	3755Laa(LIYR) x F82-46	12,559	4.2	37.61	3.4	16.69	0.6	0.4	110	3.7
Y446H88	3755Kaa(SY) x F82-46	12,450	3.0	37.01	1.2	16.82	1.4	0.3	112	2.5
Y446H87	3755Jaa(CO) x F82-46	12,184	0.0	36.65	0.0	16.60	0.0	0.8	108	2.6
Y446H90	3755Maa(LIYS) x F82-46	11,921	-3.0	35.87	-2.8	16.60	0.0	0.0	108	2.9
3755L	0755-S_1(LIYR)aa x A	9,768	10.2	31.58	11.7	15.42	-1.0	0.7	121	1.9
3755K	0755-S_1(SY)aa x A	9,534	7.5	30.47	7.2	15.66	0.5	0.0	119	1.5
3755M	0755-S_1(LIYS)aa x A	8,947	0.9	27.71	-2.5	16.15	3.7	0.0	111	2.5
3755J	0755-S_1(CO)aa x A	8,867	0.0	28.43	0.0	15.58	0.0	1.0	113	1.9
Mean		10,779		33.16		16.19		0.4	113	2.4
LSD (.05)		1,304	12.1	3.42	10.3	0.62	4.8	0.0	9	NS
C. V. (%)		12.0		10.30		3.80		272.8	8.0	62.9
F value for varieties		1.3NS		2.5NS		0.9NS		2.0NS	4.3**	1.1NS
F value for popns vs hybrids		56.7**		40.7**		38.9**		0.2NS	2.0NS	3.3NS
F value for variety x trtmts		0.1NS		0.5NS		1.4NS		0.2NS	1.2NS	0.7NS

1/ See footnote for Test 1085-1.

TEST 1185-1. PERFORMANCE AND GCA OF C0:C1 SYNTHETICS N, P, Q, & Z OF POPN-755, SALINAS, CA, 1985

4 popns x 2 trtmts x 8 reps., split-plot
1-row plots, 30 ft. long

Planted: January 14, 1985
Harvested: September 20, 1985

Variety	Description[1/]	Acre Yield: Sugar Actual	Sugar Change	Beets Actual	Beets Change	Sucrose Actual	Sucrose Change	Bolters	Root Rot	Beets/ 100'
		Lbs	%	Tons	%	%	%	%	%	Number
4755PH67	3747aa x 1755-S_1(SY)	14,472	1.7	43.09	3.1	16.81	-1.6	2.6	0.9	126
4755QH67	3747aa x 1755-S_1(LSY)	14,312	0.4	42.56	1.8	16.83	-1.4	1.3	0.0	124
4755NH67	3747aa x 1755-S_1(CO)	14,258	0.0	41.88	0.0	17.07	0.0	0.3	0.9	126
4756H67	3747aa x 3755Z(C5-MS)	14,017	-1.9	41.12	-2.0	17.04	-0.2	2.5	0.0	124
4755N	1755-S_1(CO)aa x A	12,692	0.0	38.56	0.0	16.49	0.0	2.6	0.9	137
4756	3755Z(C5-MS)aa x A	12,546	-1.2	36.21	-6.1	17.36	5.3	1.2	1.6	131
4755P	1755-S_1(SY)aa x A	12,500	-1.5	36.38	-5.7	17.17	4.1	8.9	0.3	135
4755Q	1755-S_1(LSY)aa x A	12,493	-1.6	37.18	-3.6	16.79	1.8	1.8	1.6	133
Mean		13,411		39.62		16.95		2.6	0.8	130
LSD (.05)		1,072	NS	2.95	NS	NS	NS	2.3	0.0	8
C. V. (%)		8.0		7.40		3.60		87.1	237.7	6.1
F value for entries		6.0**		7.6**		1.5NS		10.3**	0.9NS	3.4*
F value for popns vs hybrids		26.1**		28.5**		0.0NS		9.4*	1.8NS	11.8*
F value for popns x treatmts		0.2NS		1.3NS		2.3NS		7.9**	1.5NS	0.1NS

[1/] SY = sugar yield selection. LSY = low sugar yield selection. CO = unselected check synthetic from all S_1 families recombined. C5-MS = cycle 5 from mass selection. 4755 = S^f, mm, A:aa popns derived from popn-755(C3-MS). In 1982, S_1 families from popn-755(C3-MS) were topcrossed to C46 and evaluated in an incomplete block trial with 4 reps. at Salinas in 1983. On the basis of the 1983 S_1-TX trials divergent selections for SY combining ability were made and the C1 synthetics were produced in 1984 by recombining composited S_1 progeny families. At that time the variety hybrids 4755H67 were produced. Synthetic N = C0 check; P & Q = C1 divergent selection; and Z = C5 by only mass selection.

The 1983 S_1-TX progeny test was poor and it is obvious from these data that the population was not improved for performance per se or for combining ability. These results again demonstrate the critical importance of the progeny evaluation phase in progeny selection or recurrent selection.

TEST 1185-2. PERFORMANCE AND GCA OF CO:C1 SYNTHETICS N, P, Q, & Z OF POPN-755, SALINAS, CA, 1985

4 popns x 2 trtmts x 8 reps., split-plot
1-row plot, 30 ft. long

Planted: April 19, 1985
Harvested: October 29, 1985

Variety	Description[1/]	Acre Yield: Sugar Actual (Lbs)	Sugar Change (%)	Beets Actual (Tons)	Beets Change (%)	Sucrose Actual (%)	Sucrose Change (%)	Root Rot (%)	Beets/ 100' (Number)	Powdery Mildew Rating
4755NH67	3747aa x 1755-S_1(CO)	10,902	0.0	34.34	0.0	15.85	0.0	0.4	106	5.0
4755PH67	3747aa x 1755-S_1(SY)	10,680	-2.5	33.64	-2.5	15.87	0.1	0.0	110	4.6
4756H67	3747aa x 3755Z(C5-MS)	10,668	-2.7	32.17	-7.6	16.56	4.6	0.0	112	4.3
4755QH67	3747aa x 1755-S_1(LSY)	10,184	-8.2	31.95	-8.4	15.94	0.6	0.0	108	5.0
4755N	1755-S_1(CO)aa x A	8,780	0.0	28.42	0.0	15.43	0.0	0.0	117	3.0
4756	3755Z(C5-MS)aa x A	8,469	-4.5	25.76	-9.3	16.41	6.4	0.6	111	2.6
4755P	1755-S_1(SY)aa x A	8,425	-4.0	27.00	-5.0	15.60	1.1	0.3	119	3.3
4755Q	1755-S_1(LSY)aa x A	8,219	-6.4	26.80	-5.7	15.29	-0.9	0.7	109	3.6
Mean		9,541		30.01		15.87		0.2	112	3.9
LSD (.05)		991	NS	2.55	8.5	0.61	3.8	NS	NS	1.3
C. V. (%)		10.3		8.40		3.80		412.4	8.5	33.4
F value for entries		11.2**		14.3**		4.3**		0.6NS	1.7NS	4.0**
F value for popns vs hybrids		95.1**		107.1**		5.1*		3.0NS	1.8NS	16.6**
F value for popns x treatments		0.1NS		0.3NS		0.5NS		0.8NS	1.9NS	0.3NS

[1/] See footnote for Test 1185-1.

TEST 2285-NONINOCULATED. YELLOWS (BWYV) AND PERFORMANCE EVALUATION OF HYBRIDS, SALINAS, CA, 1985

Split-block with 8 replications
16 varieties x 2 virus treatments
1-row plots, 30 ft. long

Planted: February 26, 1985
Noninoculated[1/]
Harvested: October 8-9, 1985

Variety	Description[2/]	Acre Yield Sugar Lbs.	Acre Yield Beets Tons	Sucrose %	Beets/ 100'[3/] Number	Root Rot %	Non Sucrose SS %	Raw J. App. Pur. %	Extract. Sugar Lbs./T
Y446H56	C309aa x F82-46	14,765	41.18	17.89	119	0.0	3.08	85.3	305
KW 1132	KWS-Betaseed	14,390	40.40	17.77	113	5.0	2.64	87.0	309
Y431H95	C796H0 x Y331	14,350	42.18	17.06	117	1.0	3.06	84.7	289
4903H82	3755Zaa x YR-ER Y246H53	14,251	41.97	16.96	116	0.3	3.06	84.7	287
4756H68	3902aa x 3755Z	14,188	41.69	17.01	111	0.7	2.89	85.4	290
Y446H65	3217aa x F82-46	14,170	43.10	16.46	115	0.0	2.86	85.1	280
4904H82	3755Zaa x Y339H67	14,002	41.08	17.04	118	0.7	2.96	85.2	290
Y439H8	F82-546H3 x Y339	13,762	41.15	16.77	111	0.3	2.83	85.5	287
Y446H82	3755Zaa x F82-46	13,759	40.03	17.19	116	1.1	3.06	84.8	291
Y439H95	C796H0 x Y339	13,629	40.96	16.61	114	1.8	2.98	84.7	281
4905H82	3755Zaa x 3218-21	13,284	40.27	16.44	121	0.6	2.95	84.7	278
Y446H62	3212aa x F82-46	13,038	40.53	16.13	109	0.0	2.89	84.8	273
Y446H97	C796aa x F82-46	12,904	39.03	16.58	108	0.0	3.01	84.6	280
Y446H8	F82-546H3 x F82-46	12,782	38.72	16.53	104	0.3	2.92	84.9	281
US H11	(83381) C54[illegible]H3 x C36	12,279	38.99	15.70	118	0.0	2.72	85.1	267
Ritmo-4	Maribo	9,535	30.67	15.63	97	0.4	3.47	81.8	255
Mean		13,443	40.12	16.74	113	0.8	2.96	84.9	284
LSD (.05)		1,296	3.44	0.67	9	1.2	0.26	1.3	13
C. V. (%)		9.7	8.70	4.00	6.9	160.8	9.00	1.6	4.9
F value		7.3**	5.2**	6.8**	3.6**	7.6**	3.8**	4.6**	6.9**

1/ The BWYV inoculated performance and loss data are summarized on the following page. Noninoculated trtmt became infected by natural spread so measurement of % loss differences is less than actual losses due to VY.

2/ F82-46 = C46. Y331 = C31/5. 3902, Y246H53(903), Y339H67(904), & 3218-21(905) = MM, S^f, A:aa popns under development. 3212, 3217, C796, & 3755 = mm, S^f, A:aa popns. Ritmo-4 = rhizomania tolerant hybrid. KW 1132 = VY susc., high %S check.

3/ Over both treatments.

TEST 2285-BWYV INOCULATED. YELLOWS (BWYV) AND PERFORMANCE EVALUATION OF HYBRIDS
SALINAS, CA, 1985

Split-block with 8 replications
16 varieties x 2 virus treatments
1-row plots, 30 ft. long

Planted: February 26, 1985
BWYV Inoculated: May 14, 1985
Harvested: October 8-9, 1985

Variety	Description	Sugar Yield Inoc. Lbs/A	Sugar Yield Loss %	Beet Yield Inoc. T/A	Beet Yield Loss %	Sucrose Inoc. %	Sucrose Loss %	Root Rot %	Non-Suc. SS %	Raw J. App. Pur. %	Extract. Sugar Lbs/T	Mean Yellows 4/ Rating
Y446H56	C309aa x F82-46	13,956	4.3	40.64	0.3	17.16	4.0	0.0	2.90	85.5	293	1.9
Y446H65	3217aa x F82-46	13,624	4.1	42.18	2.0	16.10	2.1	0.6	2.86	84.8	273	2.1
Y431H95	C796HO x Y331	13,521	5.4	41.58	0.8	16.27	4.5	0.7	2.97	84.5	275	1.7
4756H68	3902aa x 3755Z	13,514	3.9	40.42	2.0	16.71	1.7	1.1	2.86	85.3	285	2.2
4903H82	3755Zaa x YR-ER Y246H53	13,494	4.5	40.99	1.8	16.42	3.2	0.3	2.97	84.6	278	2.0
4904H82	3755Zaa x Y339H67	13,371	3.9	40.28	1.6	16.59	2.5	0.6	2.83	85.4	283	2.2
Y446H82	3755Zaa x F82-46	13,345	2.5	40.01	-0.7	16.66	3.0	1.4	2.84	85.4	284	2.0
Y439H95	C796HO x Y339	12,895	5.0	40.24	1.3	16.01	3.6	0.3	2.80	85.0	272	1.9
4905H82	3755Zaa x 3218-21	12,891	2.4	40.34	-1.0	15.91	3.3	0.3	2.91	84.4	269	2.0
Y446H62	3212aa x F82-46	12,570	2.9	39.50	1.8	15.96	1.0	1.4	3.05	83.9	267	2.2
Y439H8	F82-546H3 x Y339	12,394	9.8	37.94	7.7	16.38	2.3	0.7	2.88	85.0	278	2.3
KW 1132	KWS-Betaseed	12,111	15.3	35.50	12.0	17.04	3.9	2.9	2.58	86.8	296	4.1
Y446H97	C796aa x F82-46	11,798	7.9	36.74	5.1	16.13	2.8	0.4	2.86	84.9	274	1.7
Y446H8	F82-546H3 x F82-46	11,682	8.1	36.39	5.4	16.07	2.7	0.3	2.81	85.1	273	2.4
US H11	(83381) C546H3 x C36	11,571	5.0	37.99	1.9	15.18	2.9	0.0	2.75	84.6	257	2.3
Ritmo-4	Maribo	8,469	11.6	27.78	9.4	15.19	2.4	0.4	3.28	82.2	249	4.5
Mean		12,575	6.0	38.66	3.2	16.24	2.9	0.7	2.88	84.8	275	2.4
LSD (.05)		1,106	NS	2.97	NS	0.74	NS	1.5	0.23	1.1	14	0.4
C. V. (%)		8.9	146.7	7.80	248.1	4.60	140.5	204.0	8.20	1.4	5.4	14.7
F value for varieties		11.4**	1.3NS	10.8**	1.7NS	4.4**	0.4NS	1.8*	3.1**	5.1**	5.1**	37.9**
F value for virus trtmt		34.9**		6.0*		9.7*		0.1NS	5.2NS	0.1NS	7.9*	
F value for variety x virus		1.2NS		1.5NS		0.5NS		1.5NS	0.9NS	0.5NS	0.3NS	

4/ Yellows symptoms scored from 0 to 9 (0 = green). Mean of 6 weekly ratings from 7/15 to 8/22/85.

TEST 2385-NONINOCULATED. YELLOWS (BWYV) AND PERFORMANCE EVALUATION OF O.P., MM GERMPLASM, SALINAS, CA, 1985

Split-block with 8 replications
16 varieties x 2 virus treatments
1-row plots, 30 ft. long

Planted: February 26, 1985
Noninoculated[1/]
Harvested: October 15-16, 1985

Variety	Description[2/]	Acre Yield Sugar	Acre Yield Beets	Sucrose	Beets/ 100'[3/]	Bolting[3/]	Root Rot	Non Suc. SS	Raw J. App. Purity	Extract. Sugar
		Lbs	Tons	%	Number	%	%	%	%	Lbs/T
Y452Z	ER-YR-PMR Y252	16,046	44.94	17.79	116	0.0	0.0	3.19	84.7	301
4102	ER-YR-PMR 4N-Z type	15,876	42.01	18.90	106	0.0	1.6	2.95	86.5	327
Y452	ER-YR-PMR Y252	15,855	44.84	17.67	113	0.0	1.0	2.87	86.0	304
Y454	ER-YR-PMR Y254	15,599	44.44	17.51	108	0.0	1.2	2.92	85.6	300
Y447	Inc. Y347	15,572	46.45	16.78	108	0.0	0.3	2.95	85.0	285
Y431	Inc. Y331(C31/5)	14,865	43.07	17.26	100	0.0	0.7	3.04	84.9	293
Y449	ER-YR-PMR Y249	14,800	43.12	17.14	110	0.0	1.2	2.88	85.5	293
Y446	ER-YR-PMR F82-46	14,760	41.92	17.64	113	0.0	0.0	3.06	85.1	300
Y441	Inc. Y341	14,747	42.58	17.31	107	0.0	0.3	3.04	85.0	294
Y439	Inc. Y339	14,724	40.39	18.24	100	0.0	0.0	3.11	85.4	311
Y448	Inc. Y348	14,557	42.66	17.04	103	0.0	0.0	3.13	84.5	288
4101	ER-YR-PMR 4N-Comp.	14,392	39.96	17.97	106	0.0	2.6	2.83	86.3	310
F83-46	Inc. F82-46(83010)	13,186	38.90	16.96	105	0.0	0.0	3.09	84.5	286
968	Inc. 468(US 75)	11,911	38.23	15.58	102	0.0	0.0	3.18	83.0	258
F81-37	Inc. C37(81101)	11,787	34.50	17.06	114	0.0	0.0	3.21	84.1	287
SP6822-0	(6519)	9,739	30.27	16.11	91	9.9	1.8	2.87	84.8	273
Mean		14,276	41.14	17.31	106	0.6	0.7	3.02	85.1	294
LSD (.05)		1,479	4.08	0.64	8.4	1.6	1.5	NS	1.1	12.5
C. V. (%)		10.5	10.00	3.70	7.9	219.2	225.2	9.10	1.4	4.3
F value		11.1**	8.1**	12.0**	4.6**	15.2**	2.2**	1.7NS	4.1**	12.5**

1/, 3/, 4/ See footnotes for tests 2285, 2485, and 2585.

2/ SP6822-0 and 468(US 75) = VY susc. checks. F83-46 = C46. Y446 = C46/2. C91 = YR-ER-PMR Y341. C92 = Y452Z (and Y452). C49 = YR-ER-PMR Y449. C31/6 = YR-ER-PMR Y331. C39 = YR-ER-PMR Y339. 4101 & 4102 = YR-ER-PMR from 4N-Z type accessions from 1981.

Note: Plot site was somewhat variable leading to higher CV's and LSD's than usual. Rhizomania was moderate in some blocks and rows and varieties appeared to respond differentially. Test reliability should be fair to good with results influenced by stands (Pythium), field variability, and rhizomania.

TEST 2385-BWYV INOCULATED. YELLOWS (BWYV) AND PERFORMANCE EVALUATION OF O.P., MM GERMPLASM, SALINAS, CA, 2985

Split-block with 8 replications
16 varieties x 2 virus treatments
1-row plots, 30 ft. long

Planted: February 26, 1985
BWYV Inoculated: May 14, 1985
Harvested: October 15-16, 1985

Variety	Description[2]	Sugar Yield		Beet Yield		Sucrose		Root Rot	Non Suc. SS	Raw J. App. Purity	Extract. Sugar	Mean Yellows[4]
		Inoc.	Loss	Inoc.	Loss	Inoc.	Loss					
		Lbs/A	%	T/A	%	%	%	%	%	%	Lbs/T	Rating
Y452	ER-YR-PMR Y252	14,418	9.8	42.54	5.3	16.83	4.9	0.0	2.99	84.8	285	2.1
Y454	ER-YR-PMR Y254	14,309	8.4	41.18	7.2	17.26	1.5	0.0	2.89	85.5	295	2.3
Y452Z	ER-YR-PMR Y252	14,210	11.5	41.20	8.3	17.13	3.7	0.0	3.05	84.8	290	2.0
Y447	Inc. Y347	14,015	9.9	42.54	8.4	16.47	1.8	0.0	2.66	86.0	283	2.4
Y449	ER-YR-PMR Y249	13,977	6.0	41.93	3.0	16.58	3.2	0.7	2.81	85.4	283	1.8
Y431	Inc. Y331(C31/5)	13,807	7.1	40.58	5.2	16.92	2.0	0.4	2.89	85.3	289	1.9
Y439	Inc. Y339	13,668	7.1	38.72	3.9	17.63	3.4	0.0	3.00	85.4	301	2.3
Y441	Inc. Y341	13,283	9.7	40.36	4.5	16.38	5.4	2.1	3.11	84.0	275	1.8
Y448	Inc. Y348	12,858	10.4	39.67	5.8	16.19	5.1	0.0	2.90	84.8	274	2.2
Y446	ER-YR-PMR F82-46	12,759	13.6	37.97	9.6	16.87	4.4	0.3	2.98	84.9	286	2.0
4102	ER-YR-PMR 4N-Z type	12,026	24.8	34.05	19.3	17.54	7.3	2.2	2.47	87.6	307	3.6
F83-46	Inc. F82-46(83010)	11,424	13.1	35.20	9.2	16.20	4.5	0.0	2.82	85.2	276	2.0
4101	ER-YR-PMR 4N Comp.	11,174	22.3	33.13	16.6	16.66	7.4	2.7	2.88	85.1	284	4.3
F81-37	Inc. C37(81101)	10,740	8.7	32.74	4.9	16.32	4.4	0.6	2.88	85.0	277	1.6
968	Inc. 468(US 75)	9,062	24.0	31.28	17.9	14.39	7.6	0.3	3.16	81.8	236	4.1
SP6822-0	(6519)	6,624	31.1	22.52	24.4	14.39	10.5	2.7	2.77	83.7	241	4.8
Mean		12,397	13.6	37.22	9.6	16.48	4.8	0.7	2.89	85.0	280	2.6
LSD (.05)		1,472	10.4	3.87	9.2	0.72	4.8	1.7	0.25	1.2	14	0.4
C. V. (%)		12.0	77.3	10.50	97.0	4.40	100.7	223.6	8.90	1.5	5.1	15.9
F value for varieties		17.1**	4.2**	15.5**	3.8**	13.1**	2.0*	2.9**	3.5**	7.1**	13.6**	43.5**
F value for virus		26.1**		25.2**		13.9**		0.1NS	6.8*	0.2NS	12.1*	
F value for variety x virus		3.2**		3.0**		1.9*		0.7NS	1.7NS	1.9*	2.0*	

TEST 2485-NONINOCULATED. YELLOWS (BWYV) AND PERFORMANCE EVALUATION OF SELF-FERTILE, MULTIGERM, RANDOM-MATING GERMPLASM, SALINAS, CA, 1985

Split-block with 8 replications
6 varieties x 2 virus treatments
1-row plots, 30 ft. long

Planted: February 26, 1985
Noninoculated[1/]
Harvested: October 16, 1985

Variety	Description[2/]	Acre Yield Sugar	Acre Yield Beets	Sucrose	Beets/ 100'[3/]	Root Rot	Non Sucrose SS	Raw J. App. Purity	Extract. Sugar
		Lbs	Tons	%	Number	%	%	%	Lbs/T
3902	Y254H53aa x A	15,423	47.53	16.23	111	0.3	2.80	85.2	276
4747	ER-YR-PMR 2747 (A,aa)	15,381	45.76	16.81	118	0.4	2.94	85.1	286
4904	Inc. Y339H67 (A)	14,638	43.86	16.67	107	1.2	2.69	86.1	287
4903	ER-YR Y246H53 (A)	13,505	39.64	16.98	107	0.3	3.15	84.3	286
F81-37	Inc. C37 (81101)	12,820	37.28	17.20	119	0.7	3.03	85.0	292
4905	ER-YR-PMR 2218-21 (A,aa)	12,472	36.91	16.88	105	0.7	3.08	84.5	285
Mean		14,040	41.83	16.79	111	0.6	2.95	85.0	285
LSD (.05)		1,562	4.07	0.57	9	NS	0.29	NS	NS
C. V. (%)		11.0	9.60	3.30	6.9	217.3	9.60	1.7	4.6
F value		5.6**	10.1**	2.8*	3.9**	0.5NS	3.0*	1.4NS	1.2NS

[1/], [3/], [4/] See footnotes for Test 2285.

[2/] 4747 (901), 3902, 4903, 4904, & 4905 = MM, S^f, A:aa popns under development to study breeding techniques and to take advantage of S_1 progeny testing and reciprocal recurrent selection for population improvement for disease resistance and performance. Popns 901, 902, 903, 904, & 905 will be similar to C37, Y54, Y46, Y39, and Y52, respectively. Popns are not all in the same phase of development: aa x A = random mating with seed only from ms plants; (A,aa) = bulk increase of seed from fertile and ms plants; and (A) = increase of fertile plants by selfing and/or sibbing. Following intra-population improvement for disease resistance and genetic structure, these MM popns will be tested against mm popns (see Tests 2285 and 2585) to identify heterotic base popns from which to initiate interpopulation improvement for sugar yield performance.

TEST 2485-BWYV INOCULATED. YELLOWS (BWYV) AND PERFORMANCE EVALUATION OF SELF-FERTILE, MULTIGERM, RANDOM-MATING GERMPLASM, SALINAS, CA, 1985

Split-block with 8 replications
6 varieties x 2 virus treatments
1-row plots, 30 ft. long

Planted: February 26, 1985
BWYV Inoculated: May 14, 1985
Harvested: October 16, 1985

Variety	Description[2]	Sugar Yield Inoc. Lbs/A	Sugar Yield Loss %	Beet Yield Inoc. T/A	Beet Yield Loss %	Sucrose Inoc. %	Sucrose Loss %	Root Rot %	Non Suc. SS %	Raw J. App. Purity %	Extract. Sugar Lbs/T	Mean Yellows[4] Rating
3902	Y254H53aa x A	13,768	10.8	43.47	8.4	15.77	2.7	0.7	2.89	84.4	266	2.4
4747	ER-YR-PMR 2747(A,aa)	13,016	15.2	40.50	11.2	16.06	4.4	1.1	2.91	84.6	272	1.8
4904	Inc. Y339H67(A)	12,587	12.9	38.63	10.8	16.31	2.0	1.1	2.75	85.5	279	2.7
4905	ER-YR-PMR 2218-21(A,aa)	11,834	4.4	36.63	0.5	16.15	4.3	0.3	3.00	84.3	272	2.2
F81-37	Inc. C37 (81101)	11,761	8.5	35.31	5.3	16.60	3.4	0.8	3.09	84.3	280	1.5
4903	ER-YR Y246H53(A)	11,526	13.2	35.50	9.5	16.18	4.6	1.2	2.91	84.7	274	2.3
Mean		12,416	10.8	38.34	7.6	16.18	3.6	0.9	2.93	84.6	274	2.2
LSD (.05)		1,486	NS	3.87	NS	NS	NS	NS	NS	NS	NS	0.4
C. V. (%)		11.80	98.1	10.00	126.5	3.70	98.8	188.7	10.60	1.9	5.0	19.1
F value for varieties		2.8*	1.1NS	5.6**	1.5NS	1.7NS	0.7NS	0.3NS	1.1NS	0.7NS	1.1NS	7.5**
F value for virus trtmt		17.6**		15.7**		5.9*		1.0NS	0.1NS	1.6NS	5.5NS	
F value for variety x virus		1.4NS		1.7NS		0.7NS		0.4NS	1.3NS	0.6NS	0.2NS	

[1], [3], [4] See footnotes for Test 2285.

[2] 4747 (901), 3902, 4903, 4904, & 4905 = MM, S^f, A:aa popns under development to study breeding techniques and to take advantage of S_1 progeny testing and reciprocal recurrent selection for population improvement for disease resistance and performance. Popns 901, 902, 903, 904, & 905 will be similar to C37, Y54, Y46, Y39, and Y52, respectively. Popns are not all in the same phase of development: aa x A = random mating with seed only from ms plants; (A,aa) = bulk increase of seed from fertile and ms plants; and (A) = increase of fertile plants by selfing and/or sibbing. Following intra-population improvement for disease resistance and genetic structure, these MM popns will be tested against mm popns (see Tests 2285 and 2585) to identify heterotic base popns from which to initiate interpopulation improvement for sugar yield performance.

TEST 2585-NONINOCULATED. YELLOWS (BWYV) AND PERFORMANCE EVALUATION OF MONOGERM, SELF-FERTILE GERMPLASM, SALINAS, CA, 1985

Split-block with 8 replications
10 varieties x 2 virus treatments
1-row plots, 30 ft. long

Planted: February 26, 1985
Noninoculated[1/]
Harvested: October 10-11, 1985

Variety	Description[2/]	Acre Yield Sugar	Acre Yield Beets	Sucrose	Beets/ 100'[3/]	Root Rot	Non Suc. SS	Raw J. App. Purity	Extract. Sugar
		Lbs	Tons	%	Number	%	%	%	Lbs/T
4796H82	3755Zaa x C796	13,370	39.12	17.08	114	0.3	3.50	82.9	283
4790K	2790-S_1(SY)aa x A	12,235	36.81	16.61	118	1.0	3.46	82.7	275
4722	ER-YR-PMR 2222(A,aa)	11,860	37.47	15.82	117	0.0	3.34	82.5	261
4790	ER-YR-PMR 9790(A,aa)	11,709	34.15	17.10	108	0.0	3.74	82.0	280
4755	3755,Z,7aa x A	11,083	32.95	16.79	116	0.0	3.63	82.2	276
4767	3217aa x A	11,001	32.16	17.09	108	0.3	3.61	82.5	282
4756	3755Zaa x A	10,917	31.94	17.13	121	0.0	3.71	82.2	281
4796H0	C796H0 x C796	10,858	32.49	16.73	117	0.0	3.56	82.4	276
F82-546H3	(82460)C562CMS x C546	9,703	28.56	16.91	103	0.0	3.64	82.2	278
4797	ER-YR-PMR 2797(A,aa)	8,915	27.84	15.99	109	1.1	3.99	80.0	256
Mean		11,165	33.35	16.73	113	0.2	3.62	82.2	275
LSD (.05)		1,290	3.57	0.68	8	0.8	0.27	1.3	14
C. V. (%)		11.6	10.70	4.10	7.2	281.5	7.40	1.6	5.1
F value		7.6**	8.4**	3.7**	4.3**	2.4*	3.4**	3.1**	3.4**

[1/], [3/], [4/] See footnotes for Test 2285.

[2/] These mm, S^f, A:aa popns are being developed and improved for combined disease resistance, genetic structure, and performance. 4790K = popn-790(C3) by S_1 progeny recurrent selection (lines C790-2,-41,-42,-55, -65,&-68 were 6 of 16 S_1 lines recombined to produce this synthetic). See footnote 2 for test 2485.

Note: This test and adjacent tests (2285, 2385, & 2485) showed considerable rhizomania in some blocks. In general, infection appeared to be late and did not appear to greatly influence yields but did cause some plot valves to be erratic leading to higher than usual CV's and LSD's. Possibly due to planting date, these late February tests showed more severe rhizomania symptoms than tests 185 through 2085 planted in January and early February. Stands in the late Feb. tests were also lower than desired and somewhat erratic due to infection by Pythium in the seedling stage.

TEST 2585-BWYV INOCULATED. YELLOWS (BWYV) AND PERFORMANCE EVALUATION OF MONOGERM, SELF-FERTILE GERMPLASM, SALINAS, CA, 1985

Split-block with 8 replications
10 varieties x 2 virus treatments
1-row plots, 30 ft. long

Planted: February 26, 1985
BWYV Inoculated May 14, 1985
Harvested: October 10-11, 1985

Variety	Description[2/]	Sugar Yield		Beet Yield		Sucrose		Root Rot	Non Suc. SS	Raw J. App. Purity	Extract. Sugar	Mean Yellows[4/]
		Inoc.	Loss	Inoc.	Loss	Inoc.	Loss					
		Lbs/A	%	T/A	%	%	%	%	%	%	Lbs/T	Rating
4796H82	3755Zaa x C796	12,161	8.2	36.06	7.1	16.82	1.4	0.0	3.30	83.6	281	2.5
4722	ER-YR-PMR 2222(A,aa)	10,831	8.9	34.69	7.3	15.52	1.7	0.3	3.20	82.8	257	2.7
4790K	2790-S_1(SY)aa x A	10,139	17.3	32.05	12.7	15.75	5.2	0.6	3.42	82.1	258	3.3
4755	3755,Z,7aa x A	10,119	8.1	31.05	5.5	16.26	3.0	0.0	3.66	81.5	265	3.5
4756	3755Zaa x A	9,857	8.8	29.57	6.5	16.73	2.3	0.0	3.62	82.2	275	3.4
4790	ER-YR-PMR 9790(A,aa)	9,761	15.5	29.91	11.3	16.26	4.8	0.0	3.48	82.3	268	3.6
4796H0	C796H0 x C796	9,480	12.2	30.20	6.8	15.61	6.6	0.0	3.63	81.1	253	2.7
4767	3217aa x A	9,396	13.6	29.22	8.2	16.08	5.8	0.7	3.47	82.2	264	3.5
F82-546H3	(82460)C562CMS x C546	7,938	17.7	25.30	11.3	15.66	7.2	0.0	3.53	81.6	255	3.7
4797	ER-YR-PMR 2797(A,aa)	7,911	10.5	25.87	6.8	15.24	4.5	0.0	3.79	80.0	244	3.7
Mean		9,759	12.1	30.39	8.3	15.99	4.3	0.2	3.51	81.9	262	3.3
LSD (.05)		1,117	NS	3.08	NS	0.76	NS	NS	NS	1.8	16	0.4
C. V. (%)		11.5	101.3	10.10	124.6	4.80	119.0	444.1	10.10	2.3	6.4	10.7
F value for varieties		10.1**	0.8NS	9.6**	0.5NS	3.8**	1.3NS	1.2NS	2.0NS	2.2*	3.3**	11.0**
F value for virus trtmt		46.4**		41.3**		18.6**		2.1NS	4.3NS	0.6NS	13.4**	
F value for variety x virus		0.8NS		0.6NS		1.3NS		2.2*	0.5NS	0.6NS	1.1NS	

Note: This test and adjacent tests(2285, 2385, & 2485) showed considerable rhizomania in some blocks. In general, infection appeared to be late and did not appear to greatly influence yields but did cause some plot valves to be erratic leading to higher than usual CV's and LSD's. Possibly due to planting date, these late February tests showed more severe rhizomania symptoms than tests 185 through 2085 planted in January and early February. Stands in the late Feb. tests were also lower than desired and somewhat erratic due to infection by Pythium in the seedling stage.

TEST 2185. VIRUS YELLOWS AREA 4 CODED VARIETY TRIAL, SALINAS, CA, 1985

18 entries x 7 reps, RCB
1-row plots, 30 ft. long

Planted: February 26, 1985
Harvested: September 24-25, 1985

Code	Variety	Source	Acre Yield Sugar	Acre Yield Beets	Sucrose	Root Rot	Beets/ 100'	Non Sucrose SS[1/]	Raw J. App. Purity	RJAP Extract. Sugar[1/]
			Lbs	Tons	%	%	Number	%	%	Lbs/T
16	84C39-032	Holly	14,101	44.10	15.96	0.8	112	2.80	85.0	271
8	USC-4	Union	12,331	38.85	15.81	2.4	104	3.07	83.7	264
5	4BG5558	Betaseed	12,171	39.31	15.42	2.3	114	2.64	85.3	263
7	HH37	Holly	12,107	37.84	15.96	0.8	114	2.86	84.8	270
12	SS-Z2	Spreckels	12,098	36.91	16.39	2.7	116	3.11	84.0	275
3	USC-3	Union	11,848	38.27	15.49	3.2	116	2.90	84.2	261
4	US H11	Std. check	11,829	38.27	15.40	0.0	120	2.86	84.3	259
2	2C0105	Betaseed	11,740	39.48	14.86	0.0	112	2.96	83.3	247
13	USC-2	Union	11,698	37.76	15.45	0.0	114	2.81	84.6	261
6	USC-1	Union	11,589	36.85	15.74	1.3	112	2.89	84.5	265
14	Hilleshog 5	Hilleshog	11,207	36.71	15.28	1.7	112	3.09	83.2	254
9	4654	Betaseed	11,077	37.36	14.80	1.1	114	2.94	83.4	246
11	Hilleshog 2	Hilleshog	11,030	34.46	15.95	0.0	108	3.06	83.8	267
1	Hilleshog 4	Hilleshog	10,524	33.18	15.85	0.3	110	2.88	84.6	268
17	Hilleshog 1	Hilleshog	10,502	33.64	15.61	0.3	107	3.07	83.5	260
18	Hilleshog 3	Hilleshog	10,280	32.99	15.56	0.8	106	3.14	83.2	259
15	SS-Z1	Spreckels	10,132	33.14	15.24	0.7	114	2.91	83.9	255
10	3 x 8814	Betaseed	9,831	32.88	14.95	2.4	117	2.99	83.3	249
Mean			11,450	36.78	15.54	1.2	112	2.94	84.0	261
LSD (.05)			1,198	3.37	0.68	2.3	NS	0.26	1.1	12
C. V. (%)			9.9	8.60	4.10	185.1	9.7	8.20	1.2	4.4
F value			5.6**	6.1**	3.0**	1.6*	0.9NS	2.0*	3.0**	3.6**

1/ Non-sucrose soluble solids, raw juice apparent purity, and RJAP extractable sugar determined from refractometer readings for total soluble solids.

TEST 2185. VIRUS YELLOWS AREA 4 CODED VARIETY TRIAL, SALINAS, CA, 1985 (Continued)

18 entries x 7 reps, RCB
1-row plots, 30 ft. long

Planted: February 26, 1985
Harvested: September 24-25, 1985

Variety	Sodium	Potassium	Amino Nit.	Impur. Value[2]	Impur. Index[2]	Imp. V. Recover. Sugar[2]	Imp. V. Recover. Sugar[2]	Emerg. 3/15[3]	Mean Yellows[4]
	PPM	PPM	PPM			%	Lbs/T	Rating	Rating
84C39-032	469	1,473	475	9,840	619	90.7	289	2.5	1.9
USC-4	527	1,936	583	12,235	777	88.3	279	1.8	2.1
4BG5558	520	1,702	481	10,651	694	89.5	276	3.1	3.0
HH37	469	1,473	477	9,858	619	90.7	289	4.1	2.5
SS-Z2	353	1,665	656	11,638	710	89.3	292	4.0	3.0
USC-3	620	1,651	514	11,186	723	89.1	276	3.5	2.3
US H11	375	1,568	531	10,285	668	89.9	277	3.4	2.1
2C0105	504	1,900	592	12,146	817	87.7	260	2.4	3.0
USC-2	444	1,590	503	10,317	669	89.9	278	3.2	1.8
USC-1	408	1,680	538	10,740	682	89.7	282	3.2	2.0
Hilleshog 5	600	1,735	590	12,053	790	88.1	269	3.7	3.0
4654	529	1,756	545	11,429	772	88.4	261	1.1	2.8
Hilleshog 2	555	1,619	546	11,181	703	89.4	285	2.5	2.9
Hilleshog 4	655	1,469	561	11,305	712	89.3	283	2.1	3.1
Hilleshog 1	548	1,835	605	12,261	785	88.2	275	3.5	3.4
Hilleshog 3	647	1,861	618	12,792	823	87.6	272	3.7	3.1
SS-Z1	630	1,733	591	12,159	801	87.9	268	3.5	3.3
3 x 8814	482	1,678	628	11,849	795	88.0	263	4.2	3.2
Mean	519	1,685	557	11,329	731	89.0	276	3.1	2.7
LSD (.05)	118	178	85	1,012	70	1.1	13	0.9	0.4
C. V. (%)	21.6	10.0	14.5	8.4	9.1	1.1	4.6	26.1	13.5
F value	4.6**	4.9**	3.2**	6.1**	6.8**	6.8**	3.9**	7.5**	14.1**

[2] Impurity value, impurity index, % recoverable sugar, and recoverable sugar per ton ddetermined from Na, K, & NH_4-N according to Am. Crystal procedure.

[3] Emergence and stand where 1 = poor to 5 = good. Rep. I deleted because of damping-off due to Pythium.

[4] Inoculated with BWYV 5/14/85. Mean virus yellows scored over six weekly ratings from 7/15/85-8/22/85 where 0 = no evidence or symptoms of yellows to 9 = 100% or severe foliar yellowing.

TEST 585. CODED VARIETY TRIAL #1: AREA 4, SALINAS, CA, 1985

20 varieties x 8 reps, RCB
2-row plots, 30 ft. long

Planted: January 11, 1985
Harvested: September 23-24, 1985

Code	Variety	Source	Acre Yield		Sucrose	Bolters	Root Rot	Beets/ 100'	Non Sucrose SS[1/]	Raw J. App. Purity[1/]
			Sugar	Beets						
			Lbs	Tons	%	%	%	Number	%	%
17	2C0105	Betaseed	16,238	46.52	17.47	0.4	1.5	136	3.02	85.2
8	4654	Betaseed	15,745	46.60	16.94	9.1	1.7	128	2.91	85.3
7	4BG5558	Betaseed	15,420	45.55	16.94	0.4	2.5	130	2.86	85.5
0	3 x 8814	Betaseed	15,390	45.20	17.06	2.1	2.6	130	2.93	85.3
15	Hill-3	Hilleshog	15,231	44.60	17.13	0.1	0.9	131	3.03	85.0
12	84C39-032	Holly	15,139	44.74	16.90	1.3	1.9	127	2.94	85.1
19	83C117-04	Holly	15,082	45.15	16.72	1.0	1.6	137	3.01	84.7
5	US H11	Std. check	15,009	46.07	16.31	0.6	0.1	131	2.94	84.7
14	Hill-1	Hilleshog	14,982	42.83	17.49	0.0	0.8	128	3.29	84.2
10	USC-4	Union	14,950	43.70	17.09	0.3	1.6	133	3.14	84.4
2	SS-Z2	Spreckels	14,898	41.87	17.81	0.3	1.0	135	3.23	84.6
20	SS-Z1	Spreckels	14,854	42.72	17.40	0.0	1.4	141	3.04	85.1
16	Hill-2	Hilleshog	14,774	42.69	17.32	0.0	1.8	124	3.12	84.7
3	83C117-05	Holly	14,624	43.66	16.74	1.6	2.2	138	2.97	84.9
13	Hill-5	Hilleshog	14,542	43.16	16.86	0.1	1.6	126	3.27	83.7
1	HH37	Holly	14,478	42.30	17.13	1.2	2.9	136	2.96	85.2
11	Hill-4	Hilleshog	13,085	38.88	16.81	1.3	3.5	123	3.04	84.6
18	USC-1	Union	11,527	34.28	16.76	0.3	1.3	115	3.29	83.5
4	USC-3	Union	10,181	30.55	16.67	1.1	2.7	91	3.23	83.7
6	USC-2	Union	10,145	30.78	16.46	1.1	1.0	96	3.23	83.6
Mean			14,315	42.09	17.00	1.1	1.7	127	3.07	84.7
LSD (.05)			1,023	2.56	0.80	1.2	1.7	7	0.25	0.9
C.V. (%)			7.2	6.20	4.80	108.3	97.1	6	8.40	1.1
F value			22.1**	27.6**	1.7*	20.4**	1.8*	22.7**	2.4**	3.4**

TEST 585. CODED VARIETY TRIAL #1: AREA 4, SALINAS, CA, 1985 (Continued)

20 varieties x 8 reps, RCB
2-row plots, 30 ft. long

Planted: January 11, 1985
Harvested: September 23-24, 1985

Variety	RJAP Extract Sugar[1]	Sodium	Potassium	Amino Nit.	Impur. Value[2]	Impur. Index[2]	Imp. V. Recover. Sugar[2]	Imp. V. Recover. Sugar[2]	Emerg. 2/10[3]
	Lbs/T	PPM	PPM	PPM			%	Lbs/T	Rating
2C0105	297	293	1,696	522	10,233	586	91.2	318	3.6
4654	289	334	1,507	456	9,274	549	91.7	311	2.6
4BG5558	289	366	1,643	462	9,786	579	91.3	309	3.3
3 x 8814	291	392	1,597	446	9,609	566	91.5	312	3.0
Hill-3	291	467	1,688	493	10,547	617	90.7	310	3.8
84C39-032	288	372	1,396	396	8,558	508	92.3	312	3.0
83C117-04	283	370	1,360	489	9,348	559	91.6	306	4.2
US H11	276	349	1,427	467	9,233	566	91.5	298	3.8
Hill-1	294	353	1,582	512	10,060	575	91.3	319	3.5
USC-4	288	366	1,723	486	10,216	598	91.0	311	3.1
SS-Z2	301	275	1,500	550	9,942	558	91.6	326	3.6
SS-Z1	296	418	1,429	497	9,768	561	91.5	318	4.1
Hill-2	293	435	1,511	514	10,196	589	91.1	315	3.2
83C117-05	284	434	1,300	400	8,580	517	92.2	309	4.3
Hill-5	282	427	1,670	510	10,520	624	90.6	305	3.8
HH37	292	347	1,323	376	8,103	473	92.8	318	2.5
Hill-4	284	585	1,381	468	9,952	593	91.1	306	2.8
USC-1	280	367	1,542	527	10,151	606	90.8	304	2.0
USC-3	279	456	1,565	524	10,489	628	90.5	302	1.2
USC-2	275	379	1,531	544	10,324	628	90.5	298	1.3
Mean	288	389	1,519	482	9,745	574	91.3	310	3.1
LSD (.05)	14	105	112	90	988	64	0.9	16	0.4
C. V. (%)	5.0	27.2	7	19	10.3	11.3	1.1	5.3	13.5
F value	2.0**	3.3**	10.2**	2.3**	3.9**	3.2**	3.2**	1.6*	33.7**

[1] Non-sucrose soluble solids, raw juice apparent purity, and RJAP extractable sugar determined from refractometer readings for total soluble solids.

[2] Impurity value, impurity index, % recoverable sugar, and recoverable sugar per ton determined from Na, K, & NH_4-N according to Am. Crystal's procedure.

[3] Emergence and stand where 1 = poor to 5 = good.

TESTS 585 & 2185. COEFFICIENTS OF CORRELATION: AREA 4 CODED VARIETY TRIALS, SALINAS, CA, 1985

Variable Code	Variable Name[2]	Variable Code [1][3]														
		1	2	3	6	8	9	10	11	12	13	14	15	18	19	20
1	Sugar Yield	--	.92	.41	.68	-.17	.47	.49	.99	-.42	.24	-.06	-.12	.99	.29	.44
2	Root Yield	.95	--	.03	.66	-.39	.46	.13	.92	-.21	.08	-.15	-.17	.91	.18	.06
3	% Sucrose	.54	.26	--	.22	.46	.13	.97	.41	-.60	.41	.22	.11	.43	.32	.98
6	Stand	.42	.48	.04	--	-.14	.31	.28	.68	-.14	-.08	-.16	-.21	.69	.29	.26
8	% NSSS	-.12	-.24	.29	-.17	--	-.82	.26	-.24	-.24	.27	.60	.50	-.19	-.29	.37
9	RJAP	.41	.38	.24	.19	-.86	--	.34	.54	-.12	-.04	-.53	-.49	.50	.53	.22
10	Ex. Sugar/T	.60	.33	.97	.08	.03	.48	--	.50	-.60	.38	.09	-.01	.52	.42	.98
11	Ex. Sugar/A	.99	.94	.54	.42	-.19	.48	.62	--	-.41	.23	-.10	-.16	.99	.32	.44
12	Sodium	-.30	-.15	-.51	.04	-.17	-.09	-.49	-.30	--	-.33	-.11	.15	-.45	-.40	-.63
13	Potassium	-.12	-.15	.02	-.35	.40	-.39	-.09	-.15	-.28	--	.38	.55	.20	-.35	.31
14	Amino-N	-.32	-.39	.08	-.24	.70	-.68	-.11	-.36	-.08	.35	--	.91	-.12	-.78	.05
15	Imp Val.	-.41	-.42	-.13	-.32	.64	-.71	-.31	-.46	.21	.59	.88	--	-.19	-.91	.09
18	Rec Sug/A	.99	.94	.56	.42	-.16	.45	.63	.99	-.32	-.17	-.37	-.48	--	.37	.47
19	% Rec Sug	.55	.46	.48	.30	-.45	.72	.62	.60	-.37	-.52	-.74	-.93	.62	--	.49
20	Rec Sug/T	.61	.34	.97	.11	.11	.40	.98	.62	-.53	-.13	-.14	-.37	.64	.68	--
28	VY Score	-.24	-.25	-.05	-.04	.11	-.15	-.09	-.24	.20	.26	.29	.41	-.26	-.38	-.15

[1] r values for test 585 are listed above the diagonal and for test 2185, below the diagonal.

[2] Variety and test means are shown in Tests 585 and 2185.

[3] r values were calculated from plot data rather than from variety means, so n = 160 & 126, respectively. Significance at 5 and 1% levels of probability for r is ±.20 and ±.25, respectively.

VARIETY TRIALS, BRAWLEY, CALIFORNIA, 1984-85

Location: USDA-ARS, Irrigated Desert Research Station

Previous crops: 1981-82 sugarbeet trials; 1982-84 cereals.
Tests located on 80 rows, north side of block K.

Fertilization: Preplant of 46:0:0 at 354 lbs/A and 11:48:0 at 290 lbs/A.
195 units N per acre and 139 units P_2O_5 per acre.

Summary: 1984-85 Tests

Test No.	Entries per Test	No. Reps.	Rows per Plot 1/	Plot Length Ft.	Harv. Date 1985	Test Design
B185	16	4	1	24	5/14	RCB
B285-1	12	8	1	24	5/14	"
B385	16	8	2	24	5/15	"
B485	32	8	1	24	5/16	"
B585	32	8	1	24	5/17	"
B285-2	12	8	1	24	5/20	"
B685	8	8	1	24	5/20	Split-plot
B785	8	8	1	24	5/20	RCB

1/ Rows 32 inches wide.

Seeding date: Sept. 5-6, 1984. First irrigation 9/11/84.

Irrigations: Sprinkled 9/11-14/84 to establish stands.
By furrow on 10/17, 11/14, 1/24, 2/20, 3/13, 4/3 and 4/22.

Thinning date: October 3-4, 1984.

Herbicide: 4 lbs/acre Chem-Hoe through irrigation water on 11/14/84.

Disease and insect control: Aerial application of Methomyl at 0.8 lbs/acre on 10/5/84 for worm control. Bayleton at 5.3 ounces ai/acre on 3/8/85 for powdery mildew control.

Remarks: Tests should have high reliability. Stands were good and uniform. Nitrogen fertility was high in brei and % sucrose was low. Tests were harvested wet. At harvest, the incidence of powdery mildew was low. A moderately high level of bolting occurred. Levels were the highest in recent years. Winter temperatures were the coldest in 15 years but the mean April temperature was 4°F above normal. No root rot occurred. Some varieties showed a charcoal type root condition (girdle scab ?) in which the surface turned black but little internal damage was apparent. This condition was related to variety, and hybrids with C562 were free of this disease whereas some hybrids without this line had moderate frequencies of infected roots. Feeding damage from Empoasca and mites was low.

Whitefly (Bemisia tabaci) transmitted lettuce infectious yellows virus (LIYV) probably occurred in 100% of the plants in Imperial Valley in 1984-5 and was the most severe since 1981-2. On 3/27/84, Dr. Liu ran ELISA tests for LIYV and BWYV from randomly sampled leaves from tests 285-1 and 285-2. In test 285-1, 13 of 20 tested positive for LIYV and 0 of 20 for BWYV; in test 285-2, 18 of 20 for LIYV and 0 of 20 for BWYV. Misses are common with phloem viruses according to Dr. Duffus and probably 100% infection with LIYV occurred. Visually 100% infection appeared to have occurred. Effects of LIY infection were severe and reduction in yields are estimated to be 20 to 30%. In our tests, we expect yields of 28-32 tons/acre rather than 22-24 tons/acre for commercial checks. Sucrose levels were also lower than expected. Soil and crown tare were much higher than expected.

LIY infection appeared to cause lateral root proliferation. Symptoms appeared similar to a mild case of rhizomania (BNYVV). Leaf loss was rapid and high crowns developed. Internal vascular necrosis and tanning to browning were common and roots were often pith, light weight, and tough. Leaves developed symptoms similar to those caused by other yellowing viruses, e.g., BWYV. These are the same symptoms that occurred in 1981-2 (see page A52-53, 1982 Bluebook Report).

Strong evidence occurred for genetic variability for reaction to LIYV as measured by sugar yield, root tare, and visable symptoms. C546H3 and probably C546 appeared to be particularly susceptible to LIYV. Within USDA's virus yellows resistant germplasm lines, moderate to high levels of tolerance did not appear to occur. Most genetic variability appeared to be within lines extracted from popn-755. The resistance or tolerance within this population may be highly heritable and dominant. Hybrids with popn-755 or some of its lines, transmitted their resistance through both single-cross and three-way hybrids and roots within these hybrids more-or-less fell into resistant (tolerant) and susceptible classes. However, in no case was a line or hybrid observed that was highly resistant or free of LIYV leaf symptoms.

In 1981-2, 84 progenies from popn-755 were evaluated S_1-TX (half-sib) progenies at Brawley. (See page A53, 1982 Bluebook Report.) These test crosses were grown under severe LIY conditions. On the basis of results from the 1982 test, S_1 lines were recombined on the criterion of high sugar yield (LIY resistant) and low sugar yield (LIY susceptible). In 1984-5, the C0 vs. C1 (LIYR) and C1 (LIYS) were tested as synthetics per se and as synthetics crossed to C46. The results are shown in the table under test B685. The C1 (LIYS) yielded only 64 and 75% of the C1 (LIYR) as the population per se and as a hybrid. The root tare for the C1 (LIYS) entries was twice as high as for the C1 (LIYR) entries. These data support the hypothesis that considerable genetic variability for disease reaction exists within sugarbeet to LIYV and that it may be relatively simply inherited.

In another contrast of differential reaction to LIYV, S_2-TX hybrids from test B583 differed by about 50% in sugar yield at Brawley but were only about 3% different at Salinas in 1984 in the absence of LIYV. These two S_2-TX hybrids (Y346H65-14 and Y346H65-26) have the same tester (C46) and

the S_2 sister lines were randomly extracted from popn-216. Popn-216 was derived from a cross between C546 (susceptible to LIY) and popn-755 that appears to segregate for tolerance. LIYV is a severe detriment to economical sugar production in the Imperial Valley but breeding lines and sources of tolerance appear to be available to partially ameliorate this problem.

We wish to acknowledge Dick Frey and Cliff Brown for their plot supervision. Sugar analyses and plot harvesting equipment were provided by Holly Sugar Company.

TEST B185. CA EVALUATION OF 2212 (3212) PROGENY, BRAWLEY, CA, 1984-85

16 entries x 4 reps, RCB
1-row plots, 24 ft. long

Planted: September 5, 1984
Harvested: May 14, 1985

Variety	Description[1/]	Acre Yield Sugar	Acre Yield Beets	Sucrose	Bolters	Beets/ 100 Ft	Clean Beets	NO_3-N[2/]
		Lbs	Tons	%	%	No.	%	Rating
Y446H32-17C	3212-17-1--5H31 x F82-46	8,097	29.20	13.89	0.0	167	90.6	4.6
Y446H31	F82-301CMS x F82-46	8,061	29.76	13.53	1.3	143	91.8	4.6
Y446H32-10C	3212-10-1--4H31 x F82-46	8,059	29.92	13.48	3.1	163	89.0	4.1
Y446H32-20C	3212-20-1--5H31 x F82-46	7,798	28.68	13.59	1.3	160	90.1	4.0
Y446H32-23C	3212-23-1--5H31 x F82-46	7,689	28.81	13.30	0.0	156	90.1	4.8
Y446H32-19C	3212-19-1--6H31 x F82-46	7,671	28.31	13.54	3.3	152	90.1	4.3
Y446H32-9C	3212-9-1--6H31 x F82-46	7,466	27.24	13.73	0.6	155	90.5	4.5
Y446H32-12C	3212-12-1--6H31 x F82-46	7,426	27.79	13.35	1.9	156	90.0	4.8
Y446H32-24C	3212-24-1--4H31 x F82-46	7,390	28.67	12.86	0.6	162	88.9	3.9
Y446H32-2C	3212-2-1--6H31 x F82-46	6,991	26.91	12.98	1.5	139	87.7	5.0
Y446H32-11C	3212-11-1--3H31 x F82-46	6,854	25.87	13.27	1.2	155	88.2	4.1
Y446H32-13C	3212-13-1--6H31 x F82-46	6,842	26.11	13.14	0.0	162	86.2	4.4
Y446H32-1C	3212-1-1--5H31 x F82-46	6,762	26.11	12.95	0.0	134	89.2	5.3
Y446H32-6C	3212-6-1--5H31 x F82-46	6,729	25.99	12.95	2.0	139	87.8	5.1
Y446H32-3C	3212-3-1--5H31 x F82-46	6,711	26.02	12.91	0.7	141	88.6	4.8
Y446H32-18C	3212-18-1--6H31 x F82-46	6,683	25.72	13.00	0.6	162	87.6	4.4
Mean		7,327	27.57	13.28	1.1	153	89.2	4.5
LSD (.05)		872	2.76	NS	NS	NS	3.0	0.8
C. V. (%)		8.4	7.00	4.10	142.9	11.8	2.3	12.8
F value		3.0**	2.4*	1.4NS	1.6NS	1.3NS	1.9*	1.9*

1/ H31 = F_1CMS hybrid between C301CMS and T-O S_1 lines. Each entry is a seed composite of three to six 3-way hybrids. The type O component of each composite traces to one original S_0 plant. The S_0 source popn-212 = (popn-755aa x C546)aa x C718. In future tests, specific 3-way hybrids will be evaluated to see if differences in performance are clustered around S_0 source plants.

2/ See footnotes for B385.

Note: LIYV infection was severe. C301 shows moderate tolerance. Of the components of popn-212, C546 and C718 are susceptible and popn-755 segregates for tolerance. The differential performance of these experimental hybrids probably is primarily due to differences in reaction to LIYV.

TEST B385. IMPERIAL VALLEY HYBRID EVALUATION OF 546H3 x MALES BRAWLEY, CA, 1984-85

16 entries x 8 reps, RCB
2-row plots, 24 ft. long

Planted: September 5, 1984
Harvested: May 15, 1985

Variety	Description	Acre Yield 1/ Sugar	Acre Yield 1/ Beets	Sucrose	Bolters	Beets/ 100 Ft	Clean Beets	NO_3-N 2/
		Lbs	Tons	%	%	No.	%	Rating
Y446H37	F83-306CMS.x F82-46 (C46)	7,922	30.34	13.04	6.5	174	92.4	4.1
HH37	Holly Hybrid	6,532	24.52	13.31	3.8	154	94.2	4.3
Y431H8	F82-546H3 x Y331 (C31/4)	6,516	23.84	13.65	0.9	165	94.2	3.5
E337H8	F78-546H3 x F81-37 (C37)	6,350	24.10	13.19	0.9	163	91.1	3.9
Y448H8	F82-546H3 x Y348	6,313	23.93	13.17	4.5	158	92.3	4.0
Y447H8	F82-546H3 x Y347	6,292	23.48	13.41	0.8	167	92.3	3.8
4905H8	F82-546H3 x 3218-21	6,228	23.40	13.30	0.4	157	90.9	4.0
Y449H8	F82-546H3 x Y349	6,085	23.50	12.96	2.2	172	91.0	3.9
Y452H8	F82-546H3 x Y352	6,065	22.61	13.41	1.1	179	90.7	4.0
Y446H8	F82-546H3 x F82-46	6,058	23.44	12.91	1.1	170	91.0	3.8
US H11	(282110) C546H3 x C36	5,956	23.71	12.55	1.1	174	90.2	4.3
Y453H8	F82-546H3 x Y353	5,865	21.81	13.43	1.8	157	91.7	3.7
4903H8	F82-546H3 x ER-YR Y246H53	5,807	22.31	13.02	0.3	155	91.4	3.9
4904H8	F82-546H3 x Y339H67	5,656	22.28	12.71	2.0	171	90.3	4.1
Y441H8	F82-546H3 x Y341	5,439	20.48	13.22	0.6	159	92.2	3.8
Y439H8	F82-546H3 x Y339	5,230	19.91	13.14	2.1	157	91.7	4.0
Mean		6,145	23.35	13.15	1.9	165	91.8	4.0
LSD (.05)		468	1.46	0.60	1.5	16.7	1.8	NS
C. V. (%)		7.7	6.3	4.6	78.3	10.2	2.0	20.5
F value		12.8**	19.0**	1.8*	10.2**	1.8*	3.5**	0.5NS

1/ Yields adjusted to clean weight basis.

2/ Brei NO_3-N by Orion probe. Ratings 1, 2,---,9 correspond to NO_3-N values of 0 to > 250 ppm and to diphenylamine spot test ratings of 1-5.

Note: Severe infection by lettuce infectious yellows (LIYV).

TEST B485. IMPERIAL VALLEY EVALUATION OF FEMALES X MALES, BRAWLEY, CA, 1984-85

32 entries x 8 reps, RCB
1-row plots, 24 ft. long

Planted: September 5, 1984
Harvested: May 16, 1985

Variety	Description	Acre Yield		Sucrose	Bolters	Beets/ 100 Ft	Clean Beets	NO_3-N
		Sugar	Beets					
		Lbs	Tons	%	%	No.	%	Rating
Y446H37	F83-306CMS x F82-46	8,775	31.32	14.06	5.7	164	92.8	3.5
E337H50	C303aa x F81-37	8,440	29.92	14.08	3.1	151	94.5	3.1
Y446H40	C303CMS x F82-46	8,380	30.42	13.76	2.1	159	93.9	3.5
Y431H37	F83-306CMS x Y331	8,336	29.94	13.95	7.7	176	95.6	3.5
E337H47	C306aa x F81-37	8,278	29.46	14.04	10.0	149	93.9	3.3
E337H31	F82-301CMS x F81-37	8,146	28.99	14.05	6.0	160	91.9	2.9
Y446H82	3755Zaa x F82-46	7,967	27.28	14.60	1.9	170	92.4	2.6
Y446H12	3812HO x F82-46	7,951	28.06	14.16	5.4	153	92.6	3.4
Y446H31	F82-301CMS x F82-46	7,813	27.50	14.18	5.6	121	93.9	3.0
4903H82	3755Zaa x ER-YR Y246H53	7,767	26.94	14.41	6.7	158	92.9	2.8
Y446H24	(C306 x C718) x F82-46	7,662	27.75	13.82	0.6	156	92.9	3.5
Y446H62	3212C1aa x F82-46	7,640	26.61	14.35	0.2	156	91.0	2.8
4905H82	3755Zaa x 3218-21	7,540	26.27	14.44	3.7	149	91.7	3.0
Y446H59	C308aa x F82-46	7,539	25.36	14.83	3.2	146	91.6	2.6
Y446H56	C309aa x F82-46	7,453	25.41	14.69	1.4	142	92.4	1.8
HH37	Holly Hybrid	7,420	24.92	14.91	1.1	171	94.5	3.1

1/, 2/ See footnotes for test B585.

3/ F82-46 = increase of C46. F81-37 = C37. Y331 = C31/4. Y246H53 (903), 3218-21 (905), 3747, and Y339H67 (904) = MM, S^f, A:aa popns. For others, see footnote 3 for test B585.

Note: Infection by LIYV was severe.

TEST B485. IMPERIAL VALLEY EVALUATION OF FEMALES X MALES, BRAWLEY, CA, 1984-85
(Cont'd.)

32 entries x 8 reps, RCB
1-row plots, 24 ft. long

Planted: September 5, 1984
Harvested: May 16, 1985

Variety	Description	Acre Yield		Sucrose	Bolters	Beets/ 100 Ft	Clean Beets	NO_3-N
		Sugar	Beets					
		Lbs	Tons	%	%	No.	%	Rating
Y446H14	3814HO x F82-46	7,287	27.72	13.12	7.0	150	92.5	3.0
Y446H22	(C301 x C546) x F82-46	7,174	26.09	13.76	1.7	154	92.5	3.3
4819H67	3747aa x C308	7,165	25.66	13.98	8.2	153	92.0	3.3
Y446H65	3217aa x F82-46	7,145	25.49	13.97	2.8	160	92.5	3.5
Y431H95	C796HO x Y331	7,117	25.37	14.05	14.9	160	94.3	2.5
Y446H13	3813HO x F82-46	7,078	26.90	13.15	4.6	162	90.9	4.0
4904H82	3755Zaa x Y339H67	7,075	24.84	14.24	6.2	146	92.9	2.3
4756H67	(3747aa) x 3755Z	7,072	25.93	13.66	5.4	146	94.0	3.3
Y446H72	C718HO x F82-46	6,924	26.06	13.29	0.3	143	92.4	3.5
Y446H97	C796aa x F82-46	6,818	23.42	14.56	3.1	144	91.6	2.4
E337H8	F78-546H3 x F81-37	6,748	23.95	14.10	0.3	161	91.3	2.9
US H11	(28211C) C546H3 x C36	6,672	24.94	13.37	1.0	167	89.5	3.8
Y446H8	F82-546H3 x F82-46	6,587	23.12	14.23	0.3	152	91.9	3.1
4790KH67	3747aa x 2790-S_1(SY)	6,359	22.98	13.81	5.7	160	89.8	3.1
Y439H95	C796HO x Y339	6,324	23.31	13.57	13.8	170	92.6	4.3
KW1132	Betaseed	5,208	17.39	14.99	9.9	159	87.3	2.4
Mean		7,371	26.23	14.07	4.7	155	92.4	3.1
LSD (.05)		715	2.22	0.65	4.0	18	2.2	0.8
C. V. (%)		9.9	8.60	4.70	87.1	11.6	2.5	26.8
F value		8.3**	11.6**	4.2**	6.9**	2.8**	4.1**	3.2**

TEST B585. IMPERIAL VALLEY EVALUATION OF FEMALES X C46, BRAWLEY, CA, 1984-85

32 entries x 8 reps, RCB
1-row plots, 24 ft. long

Planted: September 6, 1984
Harvested: May 17, 1985

Variety	Description[3]	Acre Yield[1] Sugar	Acre Yield[1] Beets	Sucrose	Bolters	Beets/ 100 Ft	Clean Beets	NO_3-N[2]
		Lbs	Tons	%	%	No.	%	Rating
Y446H82	3755Zaa x F82-46	8,122	27.49	14.71	2.4	173	94.3	3.0
Y446H40	C303CMS x F82-46	8,093	29.86	13.55	1.3	148	94.4	3.8
Y446H75	0755-129aa x F82-46	8,026	28.10	14.26	15.5	140	94.8	3.8
Y446H37	F83-306CMS x F82-46	8,024	29.48	13.58	5.7	145	94.6	4.0
Y446H39	C302CMS x F82-46	7,774	28.09	13.84	5.0	155	94.2	3.3
Y446H74	0755-125aa x F82-46	7,735	28.96	13.37	24.0	145	93.6	3.5
Y446H76	0755-133aa x F82-46	7,664	26.28	14.57	5.9	137	94.8	2.6
Y446H61	0755-112aa x F82-46	7,601	26.96	14.09	0.3	158	93.6	3.1
Y446H54	3814aa x F82-46	7,560	27.98	13.50	30.3	141	95.7	3.4
Y346H65-14	2216-14aa x F82-46	7,553	26.95	13.99	0.0	140	93.9	3.3
Y446H56	C309aa x F82-46	7,459	25.39	14.68	2.5	135	92.7	3.4
Y446H31	F82-301CMS x F82-46	7,382	27.44	13.48	2.8	125	91.8	3.6
Y446H88	3755Kaa X F82-46	7,381	28.38	12.99	14.1	155	94.0	3.9
HH37	Holly Hybrid	7,374	25.10	14.68	0.8	177	95.9	3.8
Y446H55	3755-22aa x F82-46	7,355	24.88	14.77	3.9	137	91.7	2.8
Y446H52	3812aa x F82-46	7,286	27.45	13.27	3.1	141	93.2	3.5

[1], [2] See footnotes for test B385.

[3] F82-46 = increase of C46. F81-37 = C37. 3755Z = %S sel. pop-755. 3755K = C1 Syn 1 sel. for SY from popn-755. 3755 = popn-755. 2216-14 and 2216-26 = S_2 lines from popn-216. 3212, 3216, 3217 = S^f, mm, A:aa popns. C300, 755-#'s, and 800 numbers = increases of S_1 lines from popn-755.

Note: Infection of LIYV was severe.

TEST B585. IMPERIAL VALLEY EVALUATION OF FEMALES X C46, BRAWLEY, CA, 1984-85 (Cont'd.)

32 entries x 8 reps, RCB
1-row plots, 24 ft. long

Planted: September 6, 1984
Harvested: May 17, 1985

Variety	Description[3]	Acre Yield[1] Sugar	Acre Yield[1] Beets	Sucrose	Bolters	Beets/ 100 Ft	Clean Beets	NO_3-N[2]
		Lbs	Tons	%	%	No.	%	Rating
Y446H59	C308aa x F82-46	7,111	25.09	14.18	4.7	151	92.0	3.3
Y446H58	0755-34aa x F82-46	6,981	25.05	13.94	3.2	162	93.3	3.9
Y446H62	3212C1aa x F82-46	6,917	25.21	13.68	2.1	143	93.5	3.5
Y446H65	3217aa x F82-46	6,857	25.84	13.22	4.1	154	93.4	4.0
Y446H57	0755-18aa x F82-46	6,830	27.00	12.63	19.0	147	91.9	3.6
Y446H53	3813aa x F82-46	6,715	26.84	12.49	1.5	143	89.5	3.9
Y446H64	3216aa x F82-46	6,668	23.71	14.04	1.2	133	90.0	3.4
Y446H72	C718HO x F82-46	6,578	25.22	13.02	0.0	138	92.8	4.3
Y446H8	F82-546H3 x F82-46	6,499	23.68	13.69	0.0	160	92.2	3.5
E337H8	F78-546H3 x F81-37	6,392	24.21	13.22	0.6	155	92.0	4.4
Y346H3	C562HO x F82-46	6,354	23.95	13.26	0.0	146	94.0	3.3
Y446H83	3755aa x F82-46	6,332	24.07	13.23	7.8	150	93.4	4.4
Y446H63	3214aa x F82-46	6,199	23.16	13.42	0.0	145	92.4	4.1
US H11	(282110) C546H3 x C36	5,923	23.76	12.44	1.3	161	92.2	4.1
Y446H51	3811aa x F82-46	5,912	23.70	12.51	3.8	145	91.7	3.9
Y346H65-26	2216-26aa x F82-46	3,592	16.12	11.15	0.0	148	85.9	3.9
Mean		7,008	25.79	13.54	5.2	148	92.9	3.6
LSD (.05)		771	2.26	0.76	4.4	18	2.2	0.8
C. V. (%)		11.2	8.90	5.70	86.0	12.5	2.4	22.8
F value		10.3**	10.1**	8.4**	21.5**	2.8**	5.8**	2.2**

TEST B285-1. IMPERIAL VALLEY CODED VARIETY TRIAL #1: AREA 5, BRAWLEY, CA, 1984-85

12 entries x 8 reps, RCB
1-row plots, 24 ft. long

Planted: September 5, 1984
Harvested: May 14, 1985

Variety	Description	Acre Yield Sugar	Acre Yield Beets	Sucrose	Bolters	Beets/ 100 Ft	Clean Beets	NO_3-N
		Lbs	Tons	%	%	No.	%	Rating
5-10002	Holly 84C39-032 (HH41)	8,646	29.89	14.46	1.8	171	94.1	3.4
5-10004	Union USC-4	7,878	29.33	13.43	5.8	168	92.6	4.0
5-10010	Holly 84C39-033	7,661	26.24	14.59	0.6	169	93.8	3.8
5-10009	Holly HH37	6,923	24.63	14.05	4.5	161	94.5	4.3
5-10006	Spreckels SS-NB2	6,853	24.50	14.00	0.0	174	92.5	4.5
5-10007	Holly 84C39-025	6,741	22.96	14.71	1.6	161	92.8	3.4
5-10003	Betaseed 2C0105	6,285	22.05	14.27	14.9	163	89.0	3.8
5-10012	Union USC-2	6,205	23.78	13.07	0.7	161	91.2	4.5
5-10001	Std. check US H11	5,990	22.58	13.27	2.1	167	89.9	4.4
5-10011	Union USC-1	5,972	22.05	13.54	1.3	170	90.4	3.9
5-10008	Betaseed 4654	5,682	20.83	13.65	10.3	127	85.2	3.5
5-10005	Betaseed 3X8814	5,188	19.37	13.38	2.6	155	82.8	3.6
Mean		6,669	24.02	13.87	3.8	162	90.7	3.9
LSD (.05)		549	1.80	0.57	3.9	19	2.2	0.7
C. V. (%)		8.3	7.50	4.10	101.5	12.1	2.5	19.2
F value		26.1**	24.60**	7.40**	10.6**	3.1**	20.7**	2.5*

Note: Lettuce infectious yellows was severe.

TEST B285-2. IMPERIAL VALLEY CODED VARIETY TRIAL #2: AREA 5, BRAWLEY, CA 1984-85

12 entries x 8 reps, RCB
1-row plots, 24 ft. long

Planted: September 6, 1984
Harvested: May 20, 1985

Variety	Description	Acre Yield Sugar	Acre Yield Beets	Sucrose	Bolters	Beets/ 100 Ft	Clean Beets	NO_3-N
		Lbs	Tons	%	%	No.	%	Rating
5-10002	Holly 84C39-032 (HH41)	8,259	28.40	14.55	0.6	160	94.8	2.5
5-10010	Holly 84C39-033	8,201	27.39	14.97	0.3	164	95.6	3.1
5-10004	Union USC-4	8,082	29.97	13.49	8.7	158	93.7	3.5
5-10006	Spreckels SS-NB2	7,562	26.46	14.28	0.2	166	93.8	3.2
5-10009	Holly HH37	7,307	25.31	14.46	6.7	166	96.0	2.9
5-10007	Holly 84C39-025	6,902	23.36	14.77	0.3	159	93.7	2.3
5-10011	Union USC-1	6,818	25.19	13.50	2.0	157	92.4	3.3
5-10012	Union USC-2	6,554	24.01	13.67	0.9	164	91.7	3.9
5-10003	Betaseed 2C0105	6,468	22.25	14.57	19.9	162	90.3	2.4
5-10001	Std. check US H11	6,431	25.07	12.82	2.4	170	91.9	2.9
5-10008	Betaseed 4654	6,012	21.82	13.79	14.2	139	86.6	2.1
5-10005	Betaseed 3X8814	5,679	20.90	13.56	3.4	155	86.3	2.1
Mean		7,023	25.01	14.04	5.0	160	92.2	2.8
LSD (.05)		648	2.13	0.61	4.6	NS	2.1	0.9
C. V. (%)		9.3	8.60	4.30	92.5	11.5	2.2	32.3
F value		14.00**	13.03**	9.1**	15.1**	1.5NS	18.5**	3.1**

Note: Lettuce infectious yellows was severe.

TEST B785. S_1 PROGENY RECURRENT SELECTION:
PERFORMANCE OF C0:C1:C2:C3 SYNTHETICS OF POPULATION 790, BRAWLEY, CA, 1984-85

8 entries x 8 reps, RCB
1-row plots, 24 ft. long

Planted: September 6, 1984
Harvested: May 20, 1985

Variety	Description	Acre Yield[2/] Sugar Actual change		Beet Actual change		Sucrose Actual change		Bolters	Beets/ 100'	Clean Beets
		Lbs	%	Tons	%	%	%	%	No.	%
4790K(C3)	2790-S_1(SY)aa x A	6,785	23.3	23.37	20.4	14.56	2.7	0.6	157	92.5
1790C(C1-S2)	9790-S_1aa x A	6,122	11.2	21.25	9.5	14.37	1.4	3.0	145	92.8
1790D(C2)	9790-S_1(SY)aa x A	6,049	9.9	21.15	9.0	14.31	1.0	1.5	141	92.3
7790D(C1)	5790-S_1(SY)aa x A	5,955	8.2	21.44	10.5	13.94	-1.6	4.8	127	93.7
2790(C1+1MS)	1790aa x A	5,933	7.8	20.66	6.4	14.39	1.5	5.3	133	94.3
4790J(C2-S2)	2790-S_1aa x A	5,704	3.6	20.58	6.0	13.86	-2.2	10.7	154	91.5
7790C(C0)	5790-S_1(C0)aa x A	5,504	0.0	19.41	0.0	14.17	0.0	1.5	120	93.6
4790(3MS)	ER-YR 9790 (A,aa)	5,382	-2.2	19.28	-0.6	13.98	-1.3	2.4	136	94.4
Mean		5,929		20.89		14.20		3.7	139	93.1
LSD (.05)		806	13.6	NS	NS	0.50	3.5	3.7	18.8	1.7
C. V. (%)		13.5		13.40		3.70		99.5	13.4	1.8
F value		2.3*		1.7NS		1.8*		6.0**	3.7**	3.0*

1/ C0, C1, C2, and C3 = the first synthesis of cycles 0, 1, 2, and 3 of popn-790 by S_1 progeny recurrent selection. C1-S2 = second synthesis of cycle 1. C2-S2 = second synthesis of cycle 2. C1 + 1MS = one cycle mass selection following first cycle of S_1 progeny selection. 3MS = three successive cycles of mass selection at Salinas.

2/ LIYV infection was severe. S_1 progeny tests and mass selection were run at Salinas in the absence of LIYV.

TEST B685. PERFORMANCE & CA OF CO: C1 SYNTHETICS J,K,L, AND M OF POPN-755, BRAWLEY, CA, 1984-85

4 popns x 2 trmts x 8 reps; split-plot
1-row plots, 24 ft. long

Planted: September 6, 1984
Harvested: May 20, 1985

Variety	Description[1/]	Acre Yield[2/] Sugar Actual	Sugar change	Beet Actual	Beet change	Sucrose Actual	Sucrose change	Bolters	Beets/ 100'	Clean Beets
		Lbs	%	Tons	%	%	%	%	No.	%
Y446H88	3755Kaa x F82-46	7,805	17.2	28.36	7.3	13.75	8.4	4.8	150	94.0
Y446H89	3755Laa x F82-46	7,625	14.3	28.19	6.5	13.52	6.6	7.7	145	92.7
Y446H87	3755Jaa x F82-46	6,740	0.0	26.67	0.0	12.64	0.0	3.6	148	90.1
Y446H90	3755Maa x F82-46	5,723	-16.4	23.74	-12.5	12.07	-4.3	7.0	146	88.8
3755L	0755-S_1(LIYR)aa x A	7,047	13.8	27.24	16.6	12.93	-2.2	0.7	163	94.6
3755K	0755-S_1(SY)aa x A	6,806	9.9	25.15	7.6	13.51	2.2	2.3	157	94.7
3755J	0755-S_1(CO)aa x A	6,195	0.0	23.36	0.0	13.22	0.0	1.0	161	92.6
3755M	0755-S_1(LIYS)aa x A	4,525	-27.0	19.07	-18.4	11.83	-8.7	0.9	163	89.8
Mean		6,558		25.22		12.93		3.5	154	92.2
LSD (.05)		825	12.6	2.58	10.2	0.82	6.3	3.4	NS	1.9
C. V. (%)		12.5		10.20		6.30		96.0	12.3	2.1
F value for varieties		13.5**		11.8**		5.9**		5.4**	1.3NS	11.7**
F value for popns vs hybrids		10.1*		10.6*		0.2NS		26.2**	2.1NS	36.4**
F value for popns x hybrids		0.7NS		1.8NS		1.9NS		2.0NS	0.6NS	0.7NS

1/ SY = selection for sugar yield. LIYR and LIYS = divergent selections for SY under LIY conditions. CO = check. 0755 = S^f, mm, A:aa synthetics derived from popn-9755. In 1981, 84 S_1 families from 9755 were topcrossed to C37 and the S_1-TX's evaluated in incomplete block trials at Brawley (1 rep.) and Salinas (3 reps.). In both locations, seven S_1-TX entries plus one check were maintained as sets and selection was based upon the best line(s) within each set. In the Imperial Valley, severe LIY occurred in the 1982 evaluation trial. Based upon the SY performance of the S_1-TX's, S_1 families were selected and recombined. 3755J is the CO or unselected check produced by recombining all 84 S_1 families. 3755K is the C1 Syn_1 based upon a 20% selection for SY at Salinas and Brawley. 3755L and 3755M are C1 Syn_1's from divergent selection for SY under the LIY conditions at Brawley. The variety hybrids Y446H87,88,89, and 90 were produced by crossing the CO and C1 synthetics with C46.

2/ See footnotes for B385.

TEST 185. BOLTING EVALUATION AND OBSERVATION TEST
OF GERMPLASM AND LINES, SALINAS, CA, 1985

144 entries x 2 replications
1-row plots, 27 ft. long

Planted: January 10, 1985

Variety	Description	Stand Count	Bolting[1/] 8/20	Bolting[1/] 9/23	Powd. M. Rating
		No.	%	%	8/29
964	Inc. 364 (C64)	66	1.5	1.5	4.5
968	Inc. 968 (US 75)	68	0.0	0.0	7.0
Y009	Inc. US 22/3	66	63.6	77.3	8.0
SP6822-0	6519	53	83.0	84.9	6.0
917	Inc. 417 (C17)	71	1.4	1.4	6.0
F81-37	Inc. F80-37 (C37)	70	0.0	1.4	6.0
F79-36	Inc. C36 (79377)	71	0.0	0.0	5.5
F82-36	Inc. C36 (82421)	72	0.0	0.0	5.5
F79-31	Inc. C31E2 (79427)	67	3.0	3.0	4.0
Y431	Inc. Y331 (C31/5)	68	1.5	1.5	4.0
Y323	YR-ER Y123	79	0.0	0.0	4.0
Y346	Inc. F82-46 (C46)	68	1.5	1.5	4.0
F82-46	Inc. C46 (82459)	69	1.4	1.4	2.5
F83-46	Inc. F82-46 (C46)	68	0.0	0.0	2.5
Y446	ER-YR F82-46 (C46/2)	70	0.0	0.0	3.5
Y446	Inc. F82-46 (C46)	69	0.0	0.0	4.0
Y339	YR-ER Y139	69	0.0	0.0	4.0
Y439	Inc. Y339	65	1.5	3.1	0.0
Y441	Inc. Y341	64	0.0	0.0	4.0
Y447	Inc. Y347	67	6.0	7.5	3.0
Y448	Inc. Y348	68	19.1	20.6	3.5
Y449	ER-YR Y249	67	0.0	0.0	4.0
Y449	Inc. Y349	68	1.5	1.5	4.5
Y452	ER-YR Y252	72	1.4	1.4	3.5
Y452Z	ER-YR Y252Z (C92)	65	0.0	0.0	3.5
Y452	Inc. Y352	66	0.0	3.0	4.0
Y453	Inc. Y353	58	1.7	1.7	3.5
Y354	Inc. Y254	70	0.0	0.0	4.0
Y454	ER-YR Y254	68	1.5	1.5	2.0
Y456	Y356 (3N) x F82-46	32	6.3	6.3	1.5
Y457	3N x F82-46	37	2.7	5.4	2.0
Y458	3N x F82-46	44	4.5	4.5	4.0
4101	Inc. 4N-Z	61	3.3	3.3	2.0
4102	Inc. 4N-ZZ	62	0.0	1.6	3.5
3747	2747aa x A	66	0.0	0.0	4.5
4747	ER-YR 2747	73	0.0	0.0	4.0
3902	Y254H53aa x A	65	1.5	3.1	4.0
4903	ER-YR Y246H53aa x A	71	0.0	0.0	4.5
4903A	ER-YR Y246H53	66	0.0	0.0	2.0
4904	Inc. Y339H67	64	3.1	3.1	4.0

TEST 185. BOLTING EVALUATION AND OBSERVATION TEST OF GERMPLASM AND LINES, SALINAS, CA, 1985

144 entries x 2 replications
1-row plots, 27 ft. long

Planted: January 10, 1985

Variety	Description	Stand Count	Bolting[1/] 8/20	Bolting[1/] 9/23	Powd. M. Rating
		No.	%	%	8/29
4905	3218-3221aa x A	66	0.0	0.0	4.5
4905-1,2	ER-YR 2218-19C1	67	1.5	3.0	5.0
4905-3,4	ER-YR 2220-21C1	66	0.0	0.0	4.0
3218	YR-ER 1218C1 (A,aa)	67	0.0	0.0	4.5
3219	YR-ER 1219C1 (A,aa)	77	2.6	2.6	4.5
3220	YR-ER 1220C1 (A,aa)	68	0.0	0.0	4.0
3221	YR-ER 1221C1 (A,aa)	69	0.0	0.0	4.0
4722	ER-YR 2222C1	75	0.0	0.0	4.0
4723	ER-YR 2223-28C1	62	0.0	0.0	6.0
3743H0	0740,-5H0 x 2741-5	64	3.1	3.1	4.5
2755	1755 (Iso)aa x A	67	22.4	25.4	3.5
3755Z	YR-ER (%S) 1755	71	7.0	8.5	2.0
4756	3755Zaa x A	71	0.0	0.0	3.5
4755	3755, 3755Z, 3757aa x A	71	5.6	7.0	4.0
4755N	1755-S_1(✓)aa x A	77	5.2	7.8	4.0
4755P	1755-S_1(SY)aa x A	70	12.9	15.7	4.5
4755Q	1755-S_1(LSY)aa x A	76	3.9	3.9	3.5
9790	8790aa x A	72	2.8	2.8	3.5
2790	1790 (Iso)aa x A	72	2.8	5.6	4.0
4790	ER-YR 9790	67	3.0	3.0	3.5
4790J	2790-S_1(✓)aa x A	71	8.5	11.3	5.0
4790K	2790-S_1(SY)aa x A	72	0.0	4.2	4.0
4796	3796Aaa x A (C796)	74	6.8	6.8	5.5
4796H0	3796H0 x 3796A (C796CMS)	69	0.0	1.4	6.0
4796H31	F82-301CMS x C796	73	19.2	21.9	6.0
4796H72	C718H0 x C796	73	0.0	0.0	5.5
4796H82	3755Zaa x C796	73	16.4	17.8	5.0
4797	ER-YR 2797	70	1.4	1.4	3.5
3731	3731aa x A	78	9.0	9.0	4.0
3216	Inc. T-O 2216-S_2	71	0.0	0.0	5.5
3733	Inc. T-O 2733-S_1	71	4.2	4.2	5.5
4762	Inc. 3212C1	70	0.0	1.4	3.5
4767	3217aa x A	74	16.2	21.6	4.0
4767H0	3216H0 x 3217	69	8.7	8.7	4.5
4767H72	C718H0 x 3217	75	18.7	20.0	6.0
4790-25	Inc. C790SSD-25	71	0.0	0.0	2.5
4790-33	Inc. 1790SSD-33	76	44.7	46.1	5.0
4790-69	Inc. C790SSD-69	65	1.5	1.5	4.5
4790-88	Inc. 1790SSD-88	75	0.0	0.0	7.0
4796-22	C796-22	49	0.0	0.0	6.0

TEST 185. BOLTING EVALUATION AND OBSERVATION TEST
OF GERMPLASM AND LINES, SALINAS, CA, 1985

144 entries x 2 replications
1-row plots, 27 ft. long

Planted: January 10, 1985

Variety	Description	Stand Count	Bolting[1/] 8/20	Bolting[1/] 9/23	Powd. M. Rating
		No.	%	%	8/29
4790-2	Inc. C790-2	66	0.0	0.0	5.0
4790-41	Inc. C790-41	69	0.0	0.0	4.0
4790-42	Inc. C790-42	66	0.0	0.0	5.5
4790-55	Inc. C790-55	55	1.8	3.6	3.5
4790-65	Inc. C790-65	67	0.0	0.0	4.0
4790-68	Inc. C790-68	67	3.0	4.5	4.0
F82-301	Inc. C301 (82423)	72	4.2	4.2	5.5
F82-301CMS	C301CMS x C301 (82422)	68	2.9	2.9	6.6
F83-301	Inc. F82-301 (83305)	64	17.2	18.8	4.0
F83-301CMS	C301CMS x C301 (83304)	69	1.4	1.4	4.5
F83-306	Inc. C306 (83423)	68	0.0	0.0	0.0
F83-306CMS	C306CMS x C306 (83426)	64	6.3	6.3	3.5
F83-307	Inc. C307 (83428)	46	8.7	8.7	4.5
F83-307CMS	C307CMS x C307 (83431)	55	5.5	7.3	6.0
3805	Inc. 2805 (C304)	73	0.0	0.0	4.0
3806	Inc. 2806 (C305)	69	0.0	0.0	0.0
3809	Inc. 2809 (C302)	68	10.3	10.3	3.0
3810	Inc. 2810 (C303)	73	2.7	2.7	3.5
4802	ER-YR 2802,3,4	71	1.4	2.8	4.5
4809	Inc. 3809-#gh	67	3.0	3.0	2.5
4811	Inc. 3811	74	0.0	0.0	3.5
4812	Inc. 3812	65	1.5	3.1	4.0
4813	Inc. 3813	72	1.4	1.4	2.0
4814	Inc. 3814	73	1.4	1.4	1.5
4815	Inc. 3755-22	74	0.0	0.0	4.0
4816	Inc. 3755-46 (C309)	78	2.6	2.6	5.0
4817	Inc. 0755-18	80	1.3	1.3	3.0
4818	Inc. 0755-34	74	0.0	1.4	0.0
4819	Inc. 0755-43 (C308)	65	0.0	0.0	0.0
4819	0755-43aa x A (C308)	63	0.0	0.0	0.0
4819H0	2755H0 x 0755-43	71	1.4	1.4	4.0
4819H72	C718H0 x 0755-43	69	1.4	1.4	4.0
4820	Inc. 0755-53	80	5.0	1.5	1.5
4821	Inc. 0755-112	77	0.0	0.0	2.0
4822	Inc. 0755-125	75	2.7	2.7	0.0
4823	Inc. 0755-129	70	2.9	2.9	3.5
4824	Inc. 0755-133	69	0.0	1.4	3.5
4825	Inc. 0755-4	79	20.3	21.5	2.0
4826	Inc. 0755-21	72	2.8	2.8	5.0
4827	Inc. 1755-35	74	8.1	8.1	4.0

TEST 185. BOLTING EVALUATION AND OBSERVATION TEST OF GERMPLASM AND LINES, SALINAS, CA, 1985

144 entries x 2 replications
1-row plots, 27 ft. long

Planted: January 10, 1985

Variety	Description	Stand Count	Bolting[1/] 8/20	Bolting[1/] 9/23	Powd. M. Rating
		No.	%	%	8/29
4828	Inc. 1755-40	79	1.3	1.3	2.5
4829	Inc. 1755-57	84	8.3	9.5	4.5
4830	Inc. 1757-25	74	1.4	1.4	1.5
4831	Inc. 1757-35	74	0.0	0.0	3.0
9718	Inc. C718	71	2.8	4.2	2.5
9718H0	C718H0 x C718	69	0.0	0.0	4.0
83-718	Inc. F74-718 (83246)	74	1.4	2.7	4.0
83-718H0	F74-718H0 x F74-718	67	3.0	3.0	4.5
F79-779	Inc. C779 (79435)	70	10.0	10.0	2.0
1512	Inc. 6512 (NB6)	67	0.0	0.0	5.0
F78-546	Inc. F70-546 (78156)	68	4.4	4.4	5.5
F82-546	Inc. C546 (82372)	66	0.0	0.0	6.5
F82-562	Inc. C562 (82196)	70	7.1	8.6	4.5
F82-562H0	(82195)	67	17.9	17.9	3.5
F81-566	Inc. F80-566 (81476)	65	0.0	0.0	3.0
4799 (bb)	Inc. 9799	66	9.1	9.1	6.0
F78-546H3	(78155) C562H0 x C546	71	1.4	2.8	6.5
F82-546H3	(82460) C562H0 x C546	74	0.0	2.7	6.5
1546H72	C718H0 x C546	66	3.0	3.0	5.5
1546H65	C301CMS x C546	65	10.8	10.8	5.0
1755-29H72	C718 x C301	69	14.5	14.5	6.5
84-546H72	(84236) C718CMS x C546	69	0.0	1.4	5.5
84-546H31	(84237) C301CMS x C546	74	2.7	2.7	5.0
84-546H37	(84238) C306CMS x C546	72	0.0	0.0	5.5

[1/] Planted too late to be a rigorous test for bolting resistance but ratings appear to be ranked correctly. This test readily separates the hard bolting lines (e.g., C36, C37) from the easy bolting lines (e.g., US22/3, SP6822-0), and probably the hard bolting lines from the intermediate lines (e.g., Y448, 4755), but it probably does not separate the subtle, but important, differences among the hard bolting lines.

TEST 3185. VARIETY EVALUATION FOR ERWINIA ROOT ROT AND POWDERY MILDEW, SALINAS, CA, 1985

60 entries x 4 replications, RCB
1-row plots, 20 ft. long

Planted: April 18, 1985
Inoc. Erwinia: July 17, 1985
Harvested: October 23, 1985

Entry Code	Variety Description	No. Roots	Erwinia Reaction		Powdery Mildew Score				
			DI	% Resistant	8/8/85	8/15/85	8/23/85	8/29/85	Avg.
Hill-1	Hilleshog-1	85	5.6	94.1	2.3	4.0	5.8	6.3	4.6
Hill-2	Hilleshog-2	93	2.3	96.8	2.5	4.5	6.3	6.5	4.9
Hill-3	Hilleshog-3	80	2.5	97.5	1.8	3.5	5.3	6.0	4.1
Hill-4	Hilleshog-4	94	7.3	90.4	2.8	4.5	5.8	5.8	4.7
Hill-5	Hilleshog-5	93	8.0	90.3	3.0	5.3	7.8	7.8	5.9
BS-1	4654	105	8.3	85.7	2.8	5.0	5.8	6.8	5.1
BS-2	3X8814	106	4.6	90.6	1.0	3.5	3.8	4.3	3.1
BS-3	2C0105	114	7.6	88.7	2.5	5.3	6.5	7.3	5.4
BS-4	4BG5558	109	3.8	93.6	2.8	5.5	5.0	6.0	4.8
BS-5	2C0110	80	6.6	88.8	3.5	6.0	6.5	7.5	5.9
MH-1	82MSC153	96	1.6	94.8	3.5	5.3	7.8	8.3	6.2
MH-2	MonoHy 55	107	1.8	97.2	2.0	5.0	6.8	7.5	5.3
MH-3	82MSC148	101	4.5	92.1	3.3	6.0	7.5	8.0	6.2
MH-4	MonoHy 6036	100	1.7	98.0	3.3	5.3	7.3	7.5	5.8
US-1	USC-1	103	3.1	95.1	2.8	5.5	6.5	7.3	5.5
US-2	USC-2	102	1.7	97.1	3.3	6.5	8.0	8.0	6.4
US-3	USC-3	99	3.5	93.9	2.8	5.0	6.3	7.0	5.3
US-4	USC-4	97	10.1	85.6	3.0	5.5	6.5	7.3	5.6
AS-1	WS-206	117	0.9	97.4	4.3	7.3	8.0	8.3	6.9
SS-1	SS-E1	104	0.5	98.1	4.5	7.3	8.5	8.5	7.2
SS-2	SS-Y1	100	3.3	94.0	3.0	5.0	5.0	5.8	4.7
SS-3	SS-NB2	104	3.8	94.2	3.8	5.8	7.3	7.3	6.0
SS-4	SS-LS2	109	0.5	98.2	3.0	6.3	7.5	7.5	6.1
SS-5	SS-Z2	108	1.8	97.2	3.8	5.8	7.8	8.0	6.3

TEST 3185. (Continued)

Entry Code	Variety Description	No. Roots	Erwinia Reaction		Powdery Mildew Score				
			DI	% Resistant	8/8/85	8/15/85	8/23/85	8/29/85	Avg.
SS-6	SS-Z1	92	1.2	96.7	3.8	5.8	6.8	6.8	5.8
SS-7	H83158	88	10.2	81.8	3.0	6.0	7.5	7.8	6.1
HH-1	HH23	97	4.2	92.8	2.3	5.0	5.5	6.3	4.8
HH-2	HH27	106	0.0	100.0	1.8	4.0	4.8	5.8	4.1
HH-3	HH37	107	2.4	95.3	3.0	4.8	5.8	6.3	4.9
HH-4	HH38	95	6.5	91.6	2.0	4.5	5.3	5.8	4.4
HH-5	HH40	103	1.7	98.1	2.5	5.5	6.0	6.3	5.1
HH-6	83C21-08	101	4.1	94.1	3.3	5.0	6.5	7.0	5.4
HH-7	83C21-011	105	10.3	86.7	3.5	5.3	7.3	7.5	5.9
HH-8	83C21-012	114	2.6	96.5	2.5	4.8	5.8	6.0	4.8
HH-9	83C116-02	97	4.8	94.8	3.0	5.8	6.8	7.0	5.6
HH-10	83C117-04	103	8.3	87.4	2.5	5.5	7.3	7.5	5.7
HH-11	84C39-032	97	8.4	88.7	3.3	5.8	8.0	8.3	6.3
HH-12	1459-03	101	1.7	97.0	2.3	3.3	3.8	3.8	3.3
HH-13	81-5323-02	104	18.5	77.9	2.3	4.3	6.8	7.0	5.1
HH-14	81-7335-06	100	2.9	96.0	3.5	5.5	6.0	6.8	5.4
US H11	546H3 x C36(482397)	100	1.6	96.0	4.3	6.3	8.3	8.3	6.8
US H11	546H3 x C36(482397)	105	1.2	97.1	3.5	6.3	8.3	8.5	6.6
US H11	546H3 x C36(482397)	108	1.4	94.4	3.8	6.5	8.0	8.3	6.6
US H11	546H3 x C36(482397)	107	0.0	100.0	3.5	6.8	7.8	8.5	6.6
US H11	546H3 x C36(482397)	104	1.3	96.2	3.5	6.5	8.3	8.5	6.7
US H11	546H3 x C36(482397)	111	0.2	97.3	4.5	6.5	8.0	8.3	6.8
E440	Inc. C40	99	80.5	14.1	4.8	7.8	9.0	9.0	7.6
E440	Inc. C40	94	81.8	1.3	4.5	7.5	8.8	9.0	7.4
E440	Inc. C40	101	81.3	11.9	4.5	7.5	9.0	9.0	7.5
US H10B	546H3 x C17(6169)	88	15.3	78.4	2.5	6.0	7.8	8.0	6.1
US H10B	546H3 x C17(6169)	77	21.0	67.5	3.5	4.8	7.5	8.0	5.9
US H10B	546H3 x C17(6169)	82	28.9	63.4	3.8	6.5	8.8	8.8	6.9

TEST 3185. (Continued)

Entry Code	Variety Description	No. Roots	Erwinia Reaction		Powdery Mildew Score				
			DI	% Resistant	8/8/85	8/15/85	8/23/85	8/29/85	Avg.
Y431H8	546H3 x C31/5	105	1.9	96.2	2.8	5.5	6.3	7.0	5.4
Y439H8	546H3 x Y339	101	1.0	98.0	2.3	3.5	4.8	5.8	4.1
Y441H8	546H3 x Y341	96	2.0	95.8	1.8	3.8	5.5	6.3	4.2
Y446H8	546H3 x C46	99	5.4	91.9	3.0	5.3	7.3	7.3	5.7
Y446H31	C301CMS x C46	99	4.4	90.9	3.3	7.0	8.3	8.3	6.7
Y446H56	C309aa x C46	109	3.8	95.4	5.0	7.5	8.8	9.0	7.6
Y446H59	C308aa x C46	100	6.6	92.0	3.3	6.5	8.3	8.3	6.6
Y446H96	C796aa x C46	88	1.2	96.7	3.8	6.5	8.3	8.3	6.7

COMMENTS: Erwinia root rot was less severe than in 1984, but based upon reactions of US H11 (resistant check), US H10B (interm check), and E440 (susceptible check), this was a highly reliable test. This test was probably more similar to reactions within a commercial field and natural spread than was the 1984 test. Erwinia root rot inoculation was with strains MR-1, WE-1, SP-5, UR-7, and SB-13. DI = disease index = mean % rot/root. Individual plants were scored on the scale of 0, 1, 7, 25, 50, 75, 93, and 100% rot/root. Roots with scores of 0 and 1% were considered resistant.

Powdery mildew developed fairly late but became severe. Spreader rows of US H11 (susceptible check) surrounded this plot. Disease development was uniform. A scale of 0 to 9 was used where 0 = no mildew, to 9 = 90 to 100% of leaf area covered by mildew. The mean ratings for the four dates appear to give the best approximation of the varietal reaction or area under the disease progress curve.

No. roots is the total harvest count for all four replications.

TEST 3085. GERMPLASM REACTION TO ERWINIA ROOT ROT AND POWDERY MILDEW, SALINAS, CA, 1985

192 entries x 2 replications
1-row plots, 20 ft. long

Planted: April 18, 1985
Inoc. Erwinia: July 17, 1985
Harvested: October 24-28, 1985

Variety	Description	No. Roots[3]	Erwinia Reaction[1]		Powdery Mildew Score[2]				
			DI	% Resistant	8/8/85	8/15/85	8/23/85	8/29/85	Avg.
HYBRIDS									
964H8	546H3 x 364 (US H7A)	48	1.7	93.8	3.5	5.5	7.0	8.0	6.0
USC-1	84170	49	6.1	93.8	2.5	4.5	7.0	7.5	5.4
Rizor	SES Rhizom. Tolerant	41	4.9	92.7	2.5	4.5	6.0	7.5	5.1
KW1132	Betaseed	55	14.5	78.2	2.5	4.5	6.0	6.5	4.9
HH37	82 C93-02	44	5.1	90.9	3.0	4.5	7.0	7.5	5.5
Ritmo	Maribo	35	16.9	74.3	3.0	4.5	6.5	6.5	5.1
Ritmo-1	Maribo	33	16.7	75.8	3.5	5.5	7.0	7.5	5.9
Monohikari	31705	41	13.2	85.4	3.0	5.5	6.5	7.5	5.6
US H10B	(6169) 546H3 x C17	42	33.5	61.9	3.5	5.5	8.0	8.5	6.4
US H11	(482397) 546H3 x C36	54	0.0	100.0	4.0	7.0	8.5	9.0	7.1
E440	Inc. C40	46	88.0	10.9	4.0	8.0	9.0	9.0	7.5
E337H8	F78-546H3 x F81-37	49	2.2	95.9	3.5	6.5	8.0	9.0	6.8
E337H72	C718H0 x F81-37	46	12.0	84.8	3.5	6.5	8.5	9.0	6.9
E337H31	F82-301CMS x F81-37	46	15.4	78.3	3.5	6.0	8.0	8.5	6.5
E337H47	C306aa x F81-37	48	11.9	79.2	3.0	5.5	7.0	8.0	5.9
E337H50	C303aa x F81-37	54	18.1	72.2	3.5	5.5	7.0	7.5	5.9
3747H8	F78-546H3 x 2747	49	3.8	95.9	4.0	6.0	7.0	8.0	6.3
3902H8	F78-546H3 x Y254H53	50	15.3	80.0	3.5	5.5	6.5	7.0	5.6
4903H8	F78-546H3 x ER-YR Y246H53	54	3.3	94.4	3.0	5.5	7.0	8.0	5.9
4903H82	3755Zaa x ER-YR Y246H53	47	2.5	92.6	3.5	5.0	6.5	6.5	5.4
4904H8	F82-546H3 x Y339H67	49	6.7	89.8	3.0	5.5	6.5	7.0	5.5
4904H82	3755Zaa x Y339H67	53	12.8	77.4	3.5	5.5	6.5	7.0	5.6
E440	Inc. C40	48	80.9	16.7	4.5	7.0	8.5	8.5	7.1
4905H82	3755Zaa x 3218-21	52	6.2	88.5	4.0	6.0	8.0	8.0	6.5

TEST 3085. (Continued)

Variety	Description	No. Roots[3]	Erwinia Reaction[1]		Powdery Mildew Score[2]				
			DI	% Resistant	8/8/85	8/15/85	8/23/85	8/29/85	Avg.
Y447H8	F82-546H3 x Y347	50	0.0	100.0	3.5	5.5	7.0	7.0	5.8
Y447H72	C718H0 x Y347	46	5.1	91.8	3.5	6.5	8.0	8.0	6.5
Y448H8	F82-546H3 x Y348	44	0.9	93.2	3.0	5.5	8.0	8.0	6.1
Y449H8	F82-546H3 x Y349	44	3.8	93.2	3.0	4.5	7.0	7.5	5.5
Y452H8	F82-546H3 x Y352	46	1.6	97.8	3.0	5.0	7.0	7.5	5.6
Y453H8	F82-546H3 x Y353	48	10.3	85.4	3.5	5.5	6.0	6.0	5.3
Y441H8	F82-546H3 x Y341	49	0.0	100.0	2.5	5.0	6.5	7.0	5.3
Y441H72	C718H0 x Y341	45	10.8	88.9	1.5	5.5	7.0	8.5	5.6
Y431H8	546H3 x Y331 (C31/5)	48	4.2	95.8	3.0	6.0	7.0	7.5	5.9
Y431H72	C718H0 x Y331	41	10.8	80.5	3.0	7.0	7.5	7.5	6.3
Y431H95	C796H0 x Y331	52	2.9	96.2	3.5	7.5	8.0	8.0	6.8
E440	Inc. C40	51	85.0	13.7	4.5	8.0	9.0	9.0	7.6
US H11	482397	51	0.1	98.0	4.5	7.0	9.0	9.0	7.4
Y439H8	F82-546H3 x Y339	52	3.6	96.2	3.0	5.0	6.0	6.5	5.1
Y439H72	C718H0 x Y339	46	12.6	84.8	3.0	6.0	7.5	7.5	6.0
Y439H95	C796H0 x Y339	52	5.5	94.2	3.5	5.5	7.0	7.0	5.8
Y346H8	F78-546H3 x F82-46	49	4.5	89.8	3.0	6.5	7.0	8.0	6.1
Y446H8	F82-546H3 x F82-46	41	7.3	90.2	3.5	6.5	7.5	8.0	6.4
US H10B	6169	47	39.4	53.2	4.0	6.5	9.0	9.0	7.1
Y446H31	F82-301CMS x F82-46	54	7.4	87.0	4.5	6.5	9.0	9.0	7.3
Y446H37	F83-306CMS x F82-46	55	9.2	83.6	4.0	6.0	7.5	8.0	6.4
Y446H40	C303H0 x F82-46	54	14.1	81.5	4.0	5.5	6.0	7.0	5.6
Y446H56	C309aa x F82-46	59	5.7	93.2	5.0	7.0	9.0	9.0	7.5
Y446H59	C308aa x F82-46	50	10.4	84.0	4.0	6.5	7.0	8.0	6.4
Y446H62	3212C1aa x F82-46	48	8.6	89.6	4.0	6.0	7.5	8.5	6.5
Y446H63	3214aa x F82-46	47	9.1	87.2	4.0	6.0	7.5	8.0	6.4
Y446H64	3216aa x F82-46	47	0.0	100.0	3.5	6.0	6.5	7.0	5.8
Y446H65	3217aa x F82-46	53	5.2	90.6	3.5	6.0	6.5	7.0	5.8

TEST 3085. (Continued)

Variety	Description	No. Roots[3]	Erwinia Reaction[1]		Powdery Mildew Score[2]				
			DI	% Resistant	8/8/85	8/15/85	8/23/85	8/29/85	Avg.
Y446H72	C718HO x F82-46	52	12.6	78.8	4.5	6.5	8.0	8.0	6.8
Y446H82	3755Zaa X F82-46	44	4.6	88.6	2.5	5.5	6.5	6.5	5.3
Y446H83	3755(Iso)aa x F82-46	50	8.7	90.0	3.5	5.5	7.0	8.0	6.0
Y446H85	0755(Sp)aa x F82-46	46	4.8	93.5	3.5	6.0	7.0	8.0	6.1
Y446H96	3796aa x F82-46	46	0.8	93.5	4.0	7.0	8.0	8.0	6.8
Y446H97	C796aa x F82-46	47	1.2	95.7	4.0	7.0	8.5	8.5	7.0
Y446H56	C309aa x F82-46	57	0.4	98.2	4.5	7.0	9.0	9.0	7.4
US H11	482397	55	1.9	96.4	4.5	7.5	9.0	9.0	7.5
OPEN-POLLINATED, MULTIGERM									
E440	Inc. C40	45	90.3	8.9	4.0	6.5	9.0	9.0	7.1
Y139	YR-ER Y039	50	2.0	98.0	2.5	4.5	4.5	5.0	4.1
Y339	YR-ER Y139	57	1.4	96.5	3.0	5.0	5.0	5.5	4.6
Y439	Inc. Y339	53	0.0	100.0	2.0	4.0	6.0	6.0	4.5
917 (C17)	Inc. 417	51	43.7	52.9	3.0	6.0	7.5	8.5	6.3
E337 (C37)	Inc. F81-37	50	2.0	98.0	3.5	6.0	8.0	9.0	6.6
F80-37	Inc. E937 (80463)	54	5.6	92.6	3.0	6.5	8.0	9.0	6.6
F78-36(C36)	Inc. F77-36 (78087)	51	0.0	100.0	4.0	7.0	8.0	9.0	7.0
E440	Inc. C40	47	72.3	23.4	4.5	7.5	9.0	9.0	7.5
Y452 (C92)	ER-YR-PMR Y252	52	0.5	98.0	3.0	5.0	5.5	6.0	4.9
Y452Z (C92)	ER-YR-PMR Y252	52	0.0	100.0	2.5	4.5	6.5	7.0	5.1
Y452	Inc. Y352	60	1.6	98.0	3.5	5.0	7.0	7.5	5.8
964 (C64)	Inc. 364	48	5.1	91.7	2.0	5.5	6.5	6.5	5.1
Y341	YR-ER Y141	55	3.9	94.5	1.0	4.5	6.0	6.0	4.4
Y441 (C91)	Inc. Y341	52	0.5	98.1	1.5	4.0	5.0	5.0	3.9
F79-31 (C31/2)	Inc. C31E2 (79427)	48	1.2	95.8	3.5	4.5	6.5	7.5	5.5
Y431(C31/5)	Inc. Y331	48	4.2	93.8	2.5	4.5	5.5	6.0	4.6
Y354	Inc. Y254	47	6.8	89.4	3.5	6.0	6.5	7.0	5.8
Y454	ER-YR-PMR Y254	50	1.0	98.0	3.5	6.0	7.0	7.5	6.0
968	Inc. 468 (US75)	47	15.0	78.7	3.5	7.0	8.5	9.0	7.0

TEST 3085. (Continued)

Variety	Description	No. Roots[3]	Erwinia Reaction[1]		Powdery Mildew Score[2]				
			DI	% Resistant	8/8/85	8/15/85	8/23/85	8/29/85	Avg.
E440	Inc. C40	46	86.7	10.9	4.0	7.5	9.0	9.0	7.4
F82-46	Inc. C46 (82459)	43	1.9	95.3	2.5	5.0	6.5	6.5	5.1
F83-46	Inc. F82-46 (83010)	49	3.9	93.9	3.0	5.5	6.5	7.5	5.6
F82-36	Inc. C36 (82421)	45	3.2	93.3	4.0	7.0	8.0	9.0	7.0
Y446	Inc. F82-46	39	2.6	97.4	3.5	6.0	6.5	7.5	5.9
Y446(C46/2)	ER-YR-PMR F82-46	37	5.4	91.9	2.0	4.5	5.5	6.5	4.6
Y447	Inc. Y347	44	0.0	100.0	3.5	5.5	6.5	7.0	5.6
Y448	Inc. Y348	45	0.6	97.8	3.0	5.5	6.0	6.5	5.3
Y449	Inc. Y349	51	1.5	94.1	3.5	5.5	7.0	7.0	5.8
Y449	ER-YR-PMR Y249	55	3.4	96.4	3.0	5.5	6.5	7.0	5.5
F81-37	Inc. F80-37	54	2.5	94.4	4.0	6.5	9.0	9.0	7.1
335-1(C35/1)	PMR from EDW	47	4.3	93.6	1.0	4.5	5.5	5.5	4.1
335-2(C35/2)	PMR from EDW	48	0.2	97.9	3.0	5.5	6.0	7.0	5.4
917	Inc. 417 (C17)	45	67.7	26.7	3.5	5.5	8.5	9.0	6.6
4101	ER-YR-PMR 4n 1 thru 9	45	5.4	91.1	2.5	4.0	4.5	5.0	4.0
4102	ER-YR-PMR 4nZ	50	17.7	78.0	2.5	4.0	5.0	5.0	4.1
4209-1,2	C37 & C46 x 5942	52	3.0	92.3	4.0	7.5	8.0	8.5	7.0
Y453	Inc. Y353	37	16.4	78.4	1.5	5.0	6.5	7.0	5.0
Y456	Y356 (3n) x F82-46	25	4.0	92.0	3.0	6.0	7.5	8.0	6.1
Y457	3n x F82-46	26	7.2	92.3	3.0	6.5	8.0	8.5	6.5
Y458	3n x F82-46	20	0.4	95.0	2.5	5.0	6.5	7.5	5.4
SELF-FERTILE, A:aa, MM									
4722	ER-YR-PMR 2222C1	53	0.5	98.1	2.5	4.5	4.5	4.5	4.0
4723	ER-YR-PMR 2223C1-28C1	36	8.9	86.1	3.5	6.0	7.5	8.0	6.3
3902	Y254H53aa x A	42	8.0	88.1	3.0	5.0	7.5	8.0	5.9
4903A	ER-YR Y246H53(A)	51	0.0	100.0	2.5	5.0	8.0	8.0	5.9
4903	ER-YR Y246H53aa x A	43	0.2	97.7	3.0	5.5	7.0	7.5	5.8
4904	Inc. Y339H67	47	8.5	91.5	3.0	5.0	7.0	7.0	5.5
4905-1	ER-YR-PMR 2218C1	50	10.4	88.0	2.0	4.0	6.0	6.0	4.5
4905-2	ER-YR-PMR 2219C1	51	0.1	98.0	3.0	6.0	7.5	8.0	6.1

Variety	Description	No. Roots[3]	Erwinia Reaction[1]		Powdery Mildew Score[2]				
			DI	% Resistant	8/8/85	8/15/85	8/23/85	8/29/85	Avg.
4905-3 & 4	ER-YR-PMR 2220C1 & 21C1	46	6.5	93.5	3.0	6.0	7.0	7.5	5.9
4905	3218-3221aa x A	47	2.1	97.9	3.0	6.5	8.0	8.5	6.5
E440	Inc. C40	48	87.4	12.5	4.0	7.5	9.0	9.0	7.4
3747	2747aa x A	46	6.8	91.3	3.5	7.0	7.5	8.0	6.5
4747	ER-YR-PMR2747 (A,aa)	52	0.8	94.2	2.5	6.0	7.0	7.5	5.8
SELF-FERTILE A:aa, mm									
3796	YR-ER 1796 (A,aa)	52	3.1	92.3	3.0	7.0	8.5	9.0	6.9
C796	3796aa x A	47	3.5	85.1	4.0	6.5	8.0	9.0	6.9
C796H0	3796H0 x 3796A	46	1.4	91.3	4.0	6.5	8.0	9.0	6.9
4796H72	C718H0 x C796A	45	6.9	91.1	4.0	7.0	8.0	8.5	6.9
4796H82	3755Zaa x C796A	43	2.9	93.0	4.0	6.5	8.0	9.0	6.9
F82-36	Inc. C36 (82421)	37	0.0	100.0	4.0	7.5	8.5	9.0	7.3
4797	ER-YR-PMR 2797	44	16.3	81.8	3.0	4.0	6.0	6.5	4.9
4762A	Inc. 3212C1	35	40.1	42.9	3.0	6.0	7.0	7.5	5.9
3216A	Inc. T-O Sel. 2216-S_2	50	7.9	82.0	2.5	5.0	6.0	7.0	5.1
4767	3217aa x A	39	7.1	84.6	1.5	4.5	5.5	5.5	4.3
4767H0	3216H0 x 3217	40	15.0	75.0	3.0	6.0	7.0	8.0	6.0
E440	Inc. C40	43	90.5	7.0	4.0	7.0	8.5	9.0	7.1
4225	3755Zaa x C718	45	5.6	91.1	4.0	6.5	8.0	8.0	6.6
4226-38	4226-4238 (Comp)	36	25.1	69.4	3.5	5.5	7.5	7.5	6.0
F82-546H3	F66-562H0 x F78-546	48	2.8	91.7	2.5	5.5	7.5	7.5	5.8
4802	ER-YR-PMR 2802,03,04	49	15.7	77.6	3.0	5.5	7.0	8.0	5.9
4755	3755, 3755Z, 3757aa x A	50	7.4	86.0	2.5	5.0	6.0	6.5	5.0
4756	3755Zaa x A	46	1.7	87.0	3.0	5.5	5.5	6.0	5.0
4756H0	2755H0 x 3755Z	49	8.2	85.7	2.5	5.0	5.5	6.5	4.9
2790	1790aa x A	43	12.1	86.0	2.5	5.5	6.5	7.5	5.5
4790	ER-YR-PMR 9790	45	2.6	95.6	3.0	5.5	7.0	7.5	5.8
4790K	2790-S_1(SY)aa x A	51	17.6	76.5	2.5	6.0	8.0	8.5	6.3
F82-546	Inc. C546 (82372)	28	0.0	100.0	3.0	6.5	7.5	8.5	6.4
4790-2	Inc. C790-2	52	13.3	78.8	2.5	5.0	7.5	7.5	5.6

TEST 3085. (Continued)

Variety	Description	No. Roots[3]	Erwinia Reaction[1]		Powdery Mildew Score[2]				
			DI	% Resistant	8/8/85	8/15/85	8/23/85	8/29/85	Avg.
4790-41	Inc. C790-41	53	10.6	79.2	1.5	5.0	6.0	6.5	4.8
4790-42	Inc. C790-42	54	18.6	75.9	3.5	6.0	6.0	6.5	5.5
4790-55	Inc. C790-55	50	5.9	92.0	2.5	4.5	6.5	6.5	5.0
4790-65	Inc. C790-65	59	5.8	86.4	3.0	5.0	7.0	8.0	5.8
4790-68	Inc. C790-68	48	11.5	83.3	3.0	4.5	7.0	7.0	5.4
E440	Inc. C40	50	81.2	16.0	4.0	7.0	9.0	9.0	7.3
4790-25	Inc. 1790SSD-25(C790-25)	51	2.0	92.2	0.0	5.5	5.0	5.5	4.0
4790-33	Inc. 1790SSD-33	60	0.0	100.0	2.0	4.0	4.5	4.5	3.8
4790-69	Inc. 1790SSD-69(C790-69)	45	1.1	95.6	1.0	4.0	5.5	6.5	4.3
4790-88	Inc. 1790SSD-88	48	23.1	68.8	3.5	6.5	8.5	9.0	6.9
F82-546	Inc. C546 (82372)	19	11.8	84.2	2.5	5.5	7.5	8.5	6.0
F82-562	Inc. C562 (82196)	35	10.7	68.6	3.0	5.5	7.5	7.5	5.9
4816A	Inc. C309	54	2.6	87.0	5.0	7.0	8.5	8.5	7.3
3810A	Inc. C303	47	17.8	76.6	0.0	3.0	3.5	3.0	2.4
4812	Inc. 3812	50	1.4	92.0	2.5	4.5	5.0	5.0	4.3
4813	Inc. 3813	43	2.3	95.3	2.0	2.0	4.0	4.0	3.0
4814	Inc. 3814	50	15.5	74.0	0.0	0.0	3.0	3.0	1.5
4817	Inc. 0755-18	45	2.8	93.3	1.5	3.0	5.0	5.0	3.6
4818	Inc. 0755-34	26	18.2	80.8	2.0	2.5	5.0	5.0	3.6
4819	Inc. C308	21	15.8	71.4	1.0	3.5	5.0	5.5	3.8
4819	C308aa x A	33	8.5	78.8	2.5	5.0	5.0	6.0	4.6
4819H72	C718H0 x C308	38	9.0	89.5	4.0	7.5	8.0	8.0	6.9
E440	Inc. C40	43	88.7	9.3	4.0	7.5	9.0	9.0	7.4
F82-546	Inc. C546 (22372)	25	1.0	96.0	2.5	5.5	7.5	8.5	6.0
4816	Inc. C309	54	0.6	96.3	5.0	7.0	9.0	9.0	7.5
4820	Inc. 0755-53	52	10.1	80.8	1.0	3.5	3.5	4.0	3.0
4821	Inc. 0755-112	19	30.8	63.2	0.0	1.5	3.5	3.5	2.1
4822	Inc. 0755-125	29	75.8	17.2	0.0	1.5	4.0	4.0	2.4

TEST 3085. (Continued)

Variety	Description	No. Roots[3]	Erwinia Reaction[1]		Powdery Mildew Score[2]				
			DI	% Resistant	8/8/85	8/15/85	8/23/85	8/29/85	Avg.
4823	Inc. 0755-129	22	22.1	72.7	0.0	2.0	3.5	3.5	2.3
4824	Inc. 0755-133	30	3.3	86.7	0.0	1.0	3.0	3.0	1.8
4825	Inc. 1755-4	55	10.3	85.5	1.5	3.0	3.5	3.5	2.9
4826	Inc. 1755-21	56	4.2	80.4	2.5	3.0	5.0	5.0	3.9
4827	Inc. 1755-35	54	7.4	83.3	2.5	4.0	3.5	4.0	3.5
4830	Inc. 1757-25	52	17.7	73.1	1.0	2.5	3.0	4.0	2.6
4831	Inc. 1757-35	35	4.8	94.3	2.5	3.5	4.5	5.0	3.9
F83-301	Inc. F82-301 (C301)	42	23.3	73.8	3.5	5.5	8.0	8.0	6.3
F83-301CMS	C301CMS x C301 (83304)	42	16.8	76.2	4.0	5.5	8.0	8.0	6.4
F82-36	Inc. C36 (82421)	42	7.3	90.5	4.0	6.0	8.5	8.5	6.8
F82-546H3	F66-562H0 x F78-546	44	7.1	90.9	2.0	5.5	7.0	8.0	5.6
84-546H31	F82-301H0 x F82-546	46	8.0	87.0	4.0	6.0	7.5	7.5	6.3
84-546H37	F83-306H0 x F82-546	49	7.7	85.7	4.0	6.0	8.0	8.0	6.5
84-546H72	83-718H0 x F82-546	45	10.0	77.8	3.5	6.5	8.0	8.5	6.6
83-718	Inc. F74-718 (83246)	29	30.1	62.1	3.0	5.5	6.0	7.0	5.4
83-718H0	F74-718H0 x F74-718	39	39.9	48.7	3.5	6.5	7.0	8.0	6.3
F82-562	Inc. C562 (82196)	23	28.0	52.2	2.5	6.0	7.5	8.0	6.0
F82-562H0	Inc. C562 (82195)	28	13.9	75.0	3.5	5.5	7.0	7.5	5.9
F83-306	Inc. C306 (83423)	33	23.1	69.7	0.0	2.0	4.5	4.5	2.8
F83-306CMS	C306CMS x C306	34	19.4	76.5	2.0	4.5	7.0	7.0	5.1
F82-546	Inc. C546 (82372)	24	8.0	87.5	2.0	4.5	7.0	7.0	5.1
4816A	Inc. C309	55	3.7	96.4	4.0	7.0	9.0	9.0	7.3
3796-15	Inc. 2796-6	39	4.3	94.9	3.0	5.0	7.5	8.0	5.9
3796-43	Inc. 2796-43	37	2.5	89.2	2.5	5.5	7.5	8.5	6.0
3796-22	Inc. 2796-22	14	7.7	71.4	2.0	5.0	7.0	8.0	5.5

[1], [2], [3] See Comments, Test 3185.

CURLY TOP EVALUATION OF SALINAS ENTRIES AT KIMBERLY, IDAHO, 1985
150 entries x 2 replications
Planted: June 5, 1985

Variety	Description	CT Rating[1] 8/28 RI	8/28 RII	9/25 RI	9/25 RII
HYBRIDS					
US H11	C546H3 x C36 (482397)	2	1	2	2
USC-1	(84170)	1	1	1	3
USC-2	(83048)	1	2	1	2
USC-3	(83417)	2	1	3	2
HH37	(82C93-02) 1983	2	2	2	2
SSNB2	Spreckels	2	1	2	3
Y346H3	C562H0 x F82-46	1	1	1	2
Y346H62-30	2214-S_2aa x F82-46	1	1	1	2
Y346H62-33	2214-S_2aa x F82-46	-	1	-	3
Checks[2]	US41, US33	2	2	1	3
Y346H62-24	2214-S_2aa x F82-46	1	1	1	3
Y346H64	1216aa x F82-46	-	1	-	3
Y346H65-8	2216-S_2aa x F82-46	2	1	1	2
Y346H65-14	2216-S_2aa x F82-46	2	1	1	2
Y346H65-23	2216-S_2aa x F82-46	1	1	1	2
Y346H65-38	2216-S_2aa x F82-46	2	1	1	3
Y346H65-54	2216-S_2aa x F82-46	2	1	1	2
Y346H65-62	2216-S_2aa x F82-46	1	1	1	2
Y246H59-24	1742-S_1aa x C46	2	2	2	2
Y246H59-45	1742-S_1aa x C46	2	2	2	2
Checks	US33, US41	4	2	6	2
Y346H97-6	2796-S_1aa x F82-46	1	1	2	2
Y346H97-15	2796-S_1aa x F82-46	2	2	2	3
Y346H97-22	C796-22aa x F82-46	-	2	-	2
Y346H97-28	2796-S_1aa x F82-46	2	1	1	3
Y346H97-42	2796-S_1aa x F82-46	1	2	1	2
Y346H97-43	2796-S_1aa x F82-46	2	2	1	2
Y346H97-85	2796-S_1aa x F82-46	2	1	2	2
Y346H97-114	2796-S_1aa x F82-46	-	2	-	2
Y346H97-117	2796-S_1aa x F82-46	-	1	-	2
Y346H97-123	2796-S_1aa x F82-46	1	1	1	3
Checks	US41, US33	2	2	2	3
RIZOR	SES	4	2	6	4
KW1132	3044-1 Betaseed	3	2	5	4
Ritmo-1	Maribo	4	2	4	4
US H11	546H3 x C36 (482397)	1	1	1	3
USC-1	84170	2	1	1	2
Y446H8	546H3 x F82-46	1	1	1	2
Y446H31	F82-301CMS x F82-46	1	1	1	3
Y446H37	F83-306CMS x F82-46	1	2	1	2

CURLY TOP EVALUATION OF SALINAS ENTRIES AT KIMBERLY, IDAHO, 1985
150 entries x 2 replications
Planted: June 5, 1985

Variety	Description	CT Rating1/ 8/28 RI	8/28 RII	9/25 RI	9/25 RII
Y446H40	C303H0 x F82-46	1	2	1	2
Y446H52	3812aa x F82-46	1	2	1	3
Checks	US33, US41	3	2	2	4
Y446H53	3813aa x F82-46	1	2	1	3
Y446H54	3814aa x F82-46	1	1	1	3
Y446H56	C309aa x F82-46	1	2	1	3
Y446H57	0755-18aa x F82-46	1	2	1	3
Y446H58	0755-34aa x F82-46	1	2	2	5
Y446H59	C308aa x F82-46	1	2	2	4
Y446H61	0755-112aa x F82-46	2	2	2	3
Y446H74	0755-125aa x F82-46	2	2	1	3
Y446H75	0755-129aa x F82-46	2	3	1	3
Y446H76	0755-133aa x F82-46	1	2	1	4
Checks	US41, US33	2	4	2	6
Y446H62	3212C1aa x F82-46	2	2	1	3
Y446H63	3214aa x F82-46	2	2	1	4
Y446H64	3216aa x F82-46	2	3	2	3
Y446H65	3217aa x F82-46	2	2	1	4
Y446H72	C718H0 x F82-46	1	2	2	3
Y446H82	3755Zaa x F82-46	1	2	2	4
Y446H83	3755aa x F82-46	1	2	1	3
Y446H96	C796aa x F82-46	1	2	1	3
Y446H97	3796aa x F82-46	1	2	1	3
Checks	US33, US41	2	2	3	3
E337H8	C546H3 x F81-37	1	1	1	3
Y431H8	C546H3 x C31/4	1	1	2	3
Y439H8	C546H3 x Y339	2	1	1	3
Y441H8	C546H3 x C91	1	2	1	4
Y447H8	C546Hd3 x Y347	1	1	1	3
Y448H8	C546H3 x Y348	2	2	2	3
Y449H8	C546H3 x Y349	2	2	1	3
Y452H8	C546H3 x C92	1	2	2	3
Y453H8	C546H3 x Y353	3	3	4	4
Y354H8	C546H3 x Y254	1	1	2	2
Checks	US41, US33	1	2	1	4
3747H8	C546H3 x 2747	1	1	1	3
3902H8	C546H3 x Y254H53	1	1	1	4
4903H8	C546H3 x ER-YR-Y246H53	1	2	1	3
4904H8	C546H3 x Y339H67	2	1	2	3
US H11	C546H3 x C36 (482397)	1	1	1	4

CURLY TOP EVALUATION OF SALINAS ENTRIES AT KIMBERLY, IDAHO, 1985
150 entries x 2 replications
Planted: June 5, 1985

Variety	Description	CT Rating1/ 8/28 RI	8/28 RII	9/25 RI	9/25 RII
Y431H95	C796H0 x C31/4	2	2	3	3
Y439H95	C796H0 x Y339	1	2	2	3
E337H31	F82-301CMS x F81-37	1	2	1	2
E337H47	C306aa x F81-37	1	2	1	3
E337H50	C303aa x F81-37	1	2	1	3
E337H72	C718H0 x F81-37	1	2	2	3
Checks	US33, US41	3	2	4	3
3747H31	F82-301CMS x 2747	1	2	2	3
4904H82	3755Zaa x Y339H67	2	1	2	2
4756H67	3747aa x 3755Z	3	2	3	4
4790KH67	3747aa x 2790-S_1(SY)	3	1	3	3
4756H68	3902aa x 3755Z	2	2	2	3
OPEN-POLLINATED, MM LINES					
964	Inc. 364 (C64)	2	1	3	3
Y009	Inc. US 22/3	2	2	3	2
968	Inc. 468 (US 75)	1	1	2	2
F80-37	Inc. E937 (80463)	2	2	3	3
F81-37	Inc. F80-37 (C37)	3	2	3	2
Checks	US41, US33	3	2	2	2
F78-36	Inc. F77-36	3	1	1	2
F82-36	Inc. C36	3	1	2	2
F79-31	Inc. C31E2	4	2	6	3
Y431	Inc. Y331 (C31/5)	3	3	4	5
Y439	Inc. Y339	3	3	4	4
Y339	YR-ER Y139	2	3	4	4
Y441	Inc. Y341 (C91)	2	2	1	3
Y341	YR-ER Y141	2	3	3	4
F82-46	Inc. C46	1	1	1	3
F83-46	Inc. F82-46 (83010)	1	2	1	3
Checks	US33, US41	1	1	2	3
Y446 (C46/2)	ER-YR-PMR F82-46	1	2	1	3
Y446 (C46)	Inc. F82-46	1	2	1	3
Y447	Inc. Y347	2	2	3	4
Y448	Inc. Y348	1	2	2	3
Y449	ER-YR-PMR Y249	1	2	2	4
Checks	US33, US33	2	1	3	3
Y449	Inc. Y349	1	1	2	3
Y452	Inc. Y352	1	1	1	3
Y452Z (C92)	ER-YR-PMR Y252	1	1	2	4
Y452	ER-YR-PMR Y252	1	2	2	4
Y453	Inc. Y353	2	1	3	3
Y454	ER-YR-PMR Y254	1	1	3	3
Y456 (2n)	Y356 x F82-46	2	2	3	3
E337	Inc. F81-37	2	2	1	3

CURLY TOP EVALUATION OF SALINAS ENTRIES AT KIMBERLY, IDAHO, 1985
150 entries x 2 replications
Planted: June 5, 1985

Variety	Description	CT Rating[1/] 8/28 RI	8/28 RII	9/25 RI	9/25 RII
Checks	US41, US41	1	1	2	2
4101	ER-YR-PMR 4N-Z	1	2	2	4
4102	ER-Yr-PMR 4N-ZZ	2	1	4	3
3107-13	Chinese Acc.	2	1	5	2
3747	2747aa x A	1	2	2	3
4747	ER-YR-PMR 2747	1	1	1	3
3902	Y254H53aa x A	1	1	1	2
4903	ER-YR Y246H53	1	1	1	2
4904	Inc. Y339H67	2	1	2	3
4905	3218-3221aa x A	1	2	2	3
Checks	US33, US33	1	1	3	2
SELF-FERTILE, mm LINES					
4722	ER-YR-PMR 2222C1	3	2	4	4
3743	3743-0,-1,-4,-5	2	1	2	3
4755	3755, 3755Z, 3757aa x A	1	2	2	3
4756	3755Zaa x A	2	2	2	4
4790	ER-YR-PMR 9790	2	1	3	3
3796 (C796)	Inc. T.O. Sel. 2796-S_1	2	1	2	2
3796	YR-ER 1796	1	2	1	3
4796 (C796)	3796Aaa x A	1	1	1	3
4796H82	3755Zaa x 3796A	1	1	1	2
Checks	US41, US41	1	1	2	3
4797	ER-YR-PMR 2797	1	1	1	3
4225	3755Zaa x C718	1	1	2	3
4762	Inc. 3212C1	1	1	2	3
4767	3217aa x A	1	1	1	3
4790K (C790)	2790-S_1(SY)aa x A	1	1	1	3
4790-55	C790-55	1	1	2	3
4790-68	C790-68	2	1	2	4
4790-25	C790-25	2	2	4	4
4790-69	C790-69	1	1	3	3
Checks	US33, US33	1	1	3	3
3810	Inc. C303	1	1	2	2
4816	Inc. C309	2	2	3	3
4819	Inc. C308	1	1	2	3
F83-301	Inc. F82-301 (83305)	2	1	3	3
F83-306	Inc. C306	2	1	2	3
C718	Inc. F74-718	1	1	2	3
Checks	US41, US41	1	1	2	3
F82-546	Inc. C546	1	1	2	3
F82-562	Inc. C562	1	1	2	3
F81-566	Inc. F80-566 (81476)	1	2	2	3
F78-546H3	C562H0 x C546	1	1	2	2
F82-546H3	F66-562H0 x F78-546	1	1	1	3

TEST RZM 185-1. RHIZOMANIA INFECTED YIELD TRIAL, FIELD B, SALINAS, CA, 1985

6 entries x 5 reps, RCB
2-row plots, 16 ft. long

Planted: May 30, 1985
Harvested: October 31, 1985

Variety[1]	Description	Acre Yield[2] Sugar	Acre Yield[2] Beets	Sucrose	Beets/ 100'	Non Sucrose SS	Raw J. App. Purity	Powdery Mildew[3]	Tare[4]	Harvest Count	Disease Index[5]
		Lbs	Tons	%	Number	%	%	Rating	%	Number	Rating
Rizor	SES	5,516	18.74	14.60	159	3.60	80.2	6.8	21.4	51	2.21
Mono 1167	Hilleshog	4,388	16.50	13.20	172	3.10	80.8	6.2	19.7	55	2.38
Ritmo	Maribo	3.901	14.78	13.18	146	2.95	81.7	5.4	20.3	47	2.31
Y439H8	546H3 x Y339	3,865	15.71	12.21	160	3.05	79.9	4.6	20.6	51	2.30
Y447H8	546H3 x Y347	3,074	13.64	11.17	145	3.09	78.2	5.6	26.1	46	2.67
US H11	546H3 x C36	2,492	11.39	10.87	160	3.21	77.1	6.6	22.9	51	2.81
Mean		3,873	15.13	12.54	157	3.17	79.7	5.8	21.8	50	2.45
LSD (.05)		620	2.09	0.53	NS	0.35	2.0	0.8	3.8	NS	0.35
C. V. (%)		12.2	10.50	3.20	11.6	8.30	1.9	10.3	13.3	11.6	10.80
F value		24.9**	12.6**	60.8**	1.6NS	3.8*	6.2**	9.4**	3.3*	1.6NS	4.0**

Note: Tests RZM 185-1,-2,-3,-4,-5,-6, & -7 were grown in a field plot with no known history of rhizomania infestation. Known infested soils were close by and it is probable that this plot area previously had some exposure. To assure development of uniform infection, prior to planting sifted rhizomania infested soil from the 1984 field plot was dribbled into the seed line through the planter units (10 kg/100M of row). Seed was sown with the same planter into the infested area. To promote early and as severe infection as possible, this field plot area was kept wetter than usual by sprinkler irrigation and subsequently after mid-season by furrow irrigation.

Tests RZM 185-2 thru 185-7 were planted in more or less a split-block design with types of entries maintained within separate blocks. Although not statistically correct, general comparisons between entries can be made across tests. Test RZM 185-1 was planted alongside the area used for tests 185-2 thru 185-7 and 185 appeared to have slightly less disease severity.

Tests 185-1 through 185-7 were grown under high nitrogen status and not subjected to drought stresses. Top growth was vigorous and systemic infection with BNYVV was relatively common. Other diseases were not controlled. Virus yellows (BWYV) infection was 100% and powdery mildew became moderately severe by late August. Temik at 4 lbs ai/A was used to control cyst nematode and most foliar insects. PCNB was broadcast applied post planting to help control Rhizoctonia, but Rhizoctonia infection occurred and presented some problems at harvest when individual roots were scored for rhizomania. Fodder beet, table beet, and some progeny families of sugarbeet were particularly susceptible to Rhizoctonia.

High plant populations were left at thinning. Harvest counts nearly accounted for all of the plants in the original stand counts. However, it was obvious that some small and diseased plants perished before harvest. These losses were at least partially due to rhizomania. It was observed that most plants that developed systemic BNYVV symptoms became noncompetetive and were lost. In general, the smaller plants within a plot did not show root symptoms as severely as larger plants and were probably scored too low. Thus disease scores (DI) were deflated to some degree. Our impression was that yield was a better criterion of host-plant (or line) reaction than was visable symptoms. Obvious exceptions were lines that segregated for wide differences, for example, Holly's experimental hybrids, some accessions from Fort Collins (see 185-6), and breeding lines with wide genetic variability, e.g., Y39.

1/ Rizor, Mono 1167, and Ritmo = rhizomania tolerant hybrids from Europe.

2/ Adjusted to a clean beet basis.

3/ PM scored 9/12 where 0 = 0% infection and 9 = 100% infection.

4/ Tare = total root tare. Beets were flailed in the field, dug, and then hand topped and cleaned. The whole plot was weighed, washed, trimmed, and reweighed prior to sugar analysis.

5/ Disease index = weighted rating for root symptoms. Roots prior to washing were scored on a scale of 0 to 6 where 0 = absence of visable symptoms and 6 = dead due to rhizomania. A 3 rating = classical rhizomania infected roots with "wine-glass" shape.

TEST RZM 185-2. REACTION OF HYBRIDS TO RHIZOMANIA, FIELD B, SALINAS, CA, 1985

36 entries x 4 reps, RCB
1-row plots, 16 ft. long

Planted: May 30, 1985
Harvested: November 4, 1985

Variety[1]	Description	Acre Yield[2] Sugar	Acre Yield[2] Beets	Sucrose	Beets/ 100'	Non Suc. SS	Raw J. App. Purity	Powdery Mildew[3]	Tare[4]	Harvest Count	Disease Index[5]
		Lbs	Tons	%	Number	%	%	Rating	%	No.	Rating
84C39-031	Holly	6,989	27.16	12.88	171	2.95	81.2	3.5	15.9	27	2.67
84C12-023	Holly	6,673	27.83	11.90	189	2.97	79.8	5.5	7.6	30	2.47
84C37-014	Holly	6,114	25.46	12.05	165	3.15	79.1	4.2	11.7	26	2.51
Rizor	SES, Belgium	4,897	17.92	13.75	181	3.55	79.5	6.2	25.7	29	3.08
Rizor(E-RH)	Ag Services	4,860	17.71	13.65	193	3.83	78.0	6.5	23.0	31	2.90
Monodoro	Hill. Hybrid	4,021	16.76	11.93	204	3.45	77.5	6.2	19.9	32	3.29
Ritmo-1	Maribo (Acs Co.)	3,620	14.06	12.77	198	3.10	80.4	5.5	18.5	31	3.05
Mono 1167	Hill. Hybrid	3,575	15.05	11.85	217	3.22	78.5	5.7	29.1	34	3.07
SSZ1	SS Hybrid (L80266C)	3,540	15.85	11.05	168	2.80	79.4	5.0	26.3	27	3.30
Y439H95	C796H0 x Y339	3,239	14.86	10.77	153	3.25	76.7	5.0	24.6	24	2.98
Y439H8	F82-546H3 x Y339	3,209	15.22	10.68	189	3.25	76.5	4.7	22.1	30	2.86
Ritmo-3	Maribo (Acs Co.)	3,083	13.77	11.18	179	3.20	77.7	3.5	25.5	28	3.63
Mono 4086	Hill. Hybrid	3,034	14.15	10.73	196	3.05	77.7	5.0	31.9	31	3.16
3G5008	KWS Hybrid (Beta)	3,015	13.34	11.18	178	2.67	80.6	5.5	23.7	28	3.20
Ritmo-4	Maribo (Acs Co.)	3,000	13.69	11.13	192	3.15	77.9	4.5	25.1	30	3.38
Ritmo-2	Maribo (Acs Co.)	2,958	12.46	11.68	195	3.22	78.3	5.2	33.7	31	3.26
Olympias	Desprez (SS)	2,932	12.70	11.45	190	3.15	78.2	5.2	28.8	30	3.50
Monohikari	Japan (Yugo)	2,862	11.37	12.23	204	2.65	82.0	4.7	21.4	32	3.38
SB (E)-50	Ag Services	2,792	13.20	10.13	171	3.00	76.9	4.0	26.7	27	3.67
Exp. 512	KWS Hybrid (3320-1)(Beta)	2,730	12.17	11.20	182	2.83	79.8	5.5	30.6	29	3.36

TEST RZM 185-2. REACTION OF HYBRIDS TO RHIZOMANIA, FIELD B, SALINAS, CA, 1985 (Continued)

36 entries x 4 reps, RCB
1-row plots, 16 ft. long

Planted: May 30, 1985
Harvested: November 4, 1985

Variety[1]	Description	Acre Yield[2] Sugar	Acre Yield[2] Beets	Sucrose	Beets/ 100'	Non Suc. SS	Raw J. App. Purity	Powdery Mildew[3]	Tare[4]	Harvest Count	Disease Index[5]
		Lbs	Tons	%	Number	%	%	Rating	%	No.	Rating
Ritmo	Maribo (Acs Co.)	2,712	10.93	12.40	182	3.08	80.1	5.5	22.8	29	3.36
Y446H56	C309aa x F82-46	2,615	11.51	11.40	171	3.00	79.1	5.7	42.5	27	3.16
SSNB2	SS Hybrid (L83252B)	2,594	13.63	9.48	190	2.95	76.1	4.2	28.8	30	3.70
Viva(E-VA)	Ag Services	2,508	11.20	10.73	157	2.58	80.6	5.0	30.0	25	3.46
Y446H82	3755Zaa x F82-46	2,351	10.34	11.40	156	3.28	77.6	4.7	33.7	25	3.66
Y446H65	3217aa x F82-46	2,318	11.39	10.20	187	3.15	76.4	4.7	28.3	30	3.47
Y431H8	F82-546H3 x C31/5	2,223	10.57	10.52	185	3.15	76.8	3.5	27.9	29	3.53
HH37	82-C93-02 Holly	2,154	10.77	9.88	182	3.38	74.2	3.7	34.2	29	3.60
Y452H8	F82-546H3 x Y352	2,114	10.42	10.10	178	3.15	76.1	4.7	28.4	28	3.36
Y447H8	F82-546H3 x Y347	2,096	11.22	9.27	181	3.17	74.3	5.0	32.3	29	3.24
4904H8	F82-546H3 x Y339H67	2,042	10.51	9.63	184	3.47	73.3	3.7	30.0	29	3.34
KW 1132	KWS Hybrid (3044-1)(Beta)	1,933	8.72	11.07	167	2.88	79.3	3.2	38.9	26	3.63
E337H8	F78-546H3 x F81-37	1,828	10.72	8.55	168	3.75	69.3	5.2	45.0	27	3.93
Y446H8	F82-546H3 x F82-46	1,683	8.60	9.60	159	3.00	76.0	3.5	46.7	25	3.67
US H11	546H3 x C36 (482397)	1,603	8.99	9.02	179	3.15	74.0	5.2	45.7	28	3.66
US H11	546H3 x C36 (482397)	1,583	8.28	9.40	179	3.13	75.0	5.0	34.8	28	3.58
Mean		3,097	13.68	11.02	181	3.13	77.6	4.8	28.4	29	3.31
LSD (.05)		966	3.71	1.07	31	0.46	3.1	NS	13.8	5	0.54
C. V. (%)		22.2	19.30	6.90	12.5	10.50	2.9	29.3	34.7	12.5	11.60
F value		14.8**	12.7**	10.7**	1.6*	2.7**	5.1**	1.4NS	3.1**	1.6*	3.2**

[1] Accessions and USDA hybrids.

[2], [3], [4], [5] See footnotes for Test RZM 185-1.

TEST RZM 185-3. REACTION OF MULTIGERM GERMPLASM TO RHIZOMANIA, FIELD B, SALINAS, CA, 1985

28 entries x 4 reps, RCB
1-row plots, 16 ft. long

Planted: May 30, 1985
Harvested: November 5, 1985

Variety[1]	Description	Acre Yield[2] Sugar	Acre Yield[2] Beets	Sucrose	Beets/ 100'	Non Suc. SS	Raw J. App. Purity	Powdery Mildew[3]	Tare[4]	Harvest Count	Disease Index[5]
		Lbs	Tons	%	Number	%	%	Rating	%	No.	Rating
Y439	Inc Y339	4,909	17.93	13.68	159	2.90	82.5	2.7	17.6	25	2.83
Y341	YR-ER Y141	3,833	15.38	12.45	173	3.10	80.0	2.7	15.7	27	3.29
64308PL	Italy (Alba)	3,687	14.79	12.55	185	3.35	78.8	5.7	24.9	29	3.14
Y339	YR-ER Y139	3,608	13.79	12.95	171	3.10	80.4	1.2	26.2	27	3.02
Y441	Inc Y341	3,592	14.27	12.52	156	3.05	80.4	1.7	20.2	25	3.26
Y431	Inc Y331 (C31/5)	3,498	14.06	12.40	176	2.97	80.5	2.5	20.7	28	3.19
Y347	YR-ER Y147	3,490	13.65	12.70	192	2.90	81.3	3.5	19.3	30	3.21
Y447	Inc Y347	3,344	13.34	12.52	154	2.67	82.2	3.5	23.8	24	3.26
Y449	ER-YR-PMR Y249	3,248	13.95	11.57	170	3.13	78.7	5.5	22.6	27	3.43
Y449	Inc Y349	3,189	13.35	11.73	156	3.15	78.3	3.2	22.6	25	3.47
Y448	Inc Y348	3,178	12.55	12.57	153	3.13	80.1	3.0	30.8	24	3.57
Y446(C46/2)	ER-YR-PMR F82-46	3,120	12.71	12.23	181	3.20	79.2	2.7	30.6	29	3.55
Y446 (C46)	Inc F82-46	3,072	12.65	12.18	145	3.15	79.3	4.2	30.4	23	3.75
Y452	Inc Y352	2,851	11.90	11.95	184	3.42	77.7	4.7	25.4	29	3.26
70026PL	Italy (Alba)	2,750	10.81	12.85	137	2.97	81.3	5.2	27.7	22	3.16
Y452 (C92)	ER-YR-PMR Y252	2,652	10.97	12.05	164	3.45	77.7	3.2	24.9	26	3.21
Y454	ER-YR-PMR Y254	2,569	11.37	11.20	193	3.38	76.6	2.5	22.7	31	3.32
9212	F_3 (C17*3 x FC702/2)	2,564	11.08	11.57	173	3.03	79.2	5.0	23.6	27	3.12
Y453	Inc Y353	2,475	10.39	11.75	125	3.00	79.5	2.5	23.4	20	3.66
Y126	NB Y926	2,359	9.63	12.25	193	2.65	83.1	3.7	43.5	31	3.54

TEST RZM 185-3. REACTION OF MULTIGERM GERMPLASM TO RHIZOMANIA, FIELD B, SALINAS, CA, 1985 (Continued)

28 entries x 4 reps, RCB
1-row plots, 16 ft. long

Planted: May 30, 1985
Harvested: November 5, 1985

Variety[1]	Description	Acre Yield[2] Sugar	Beets	Sucrose	Beets/ 100'	Non Suc. SS	Raw J. App. Purity	Powdery Mildew[3]	Tare[4]	Harvest Count	Disease Index[5]
		Lbs	Tons	%	Number	%	%	Rating	%	No.	Rating
Com-40	Greece	2,285	9.40	12.18	178	3.25	78.9	5.5	25.5	28	3.54
F81-37	Inc C37 (81101)	2,202	9.48	11.50	168	3.35	77.3	5.7	24.5	27	2.90
Y123 (C15)	NB Y923	2,130	10.42	10.23	165	3.03	77.1	1.5	25.3	26	3.61
Y106	Inc Y906 (R&G Old-Type)	1,924	9.52	10.13	134	3.40	74.8	3.2	27.9	21	3.61
F82-36	Inc C36 (82421)	1,596	7.93	10.00	171	3.55	73.7	5.5	43.5	27	3.74
8402	Inc C63T x 4N-MM Janasz	1,552	8.29	9.43	156	2.92	76.2	1.7	31.9	25	3.81
SP6822-0	(6519)	1,216	6.95	8.75	148	3.63	70.5	4.2	35.1	23	3.52
Y905	Inc R&G Pioneer	1,035	5.74	8.55	153	3.78	69.0	3.2	31.9	24	3.68
Mean		2,783	11.65	11.66	165	3.16	78.4	3.5	26.5	26	3.38
LSD (.05)		991	3.56	1.30	29	NS	5.1	2.0	14.1	4	0.44
C. V. (%)		25.3	21.70	7.90	12.5	15.80	4.7	40.2	37.9	12.5	9.20
F value		6.1**	4.7**	7.8**	3.0**	1.1NS	3.2**	3.6**	1.7*	3.0**	2.9**

[1] See descriptions of germplasm in "Sources, Pedigrees, and Commonalty of Germplasm" in this report. Lines with "Y" numbers are MM, S^sS^s breeding lines within the USDA project at Salinas. Improved or reselected versions of Y439 & Y339, Y341 & Y441, Y431, Y449, and Y452 have been or will be released as C39, C91, C31/6, C49 and C92, respectively. Y126 = reselected line from US 56/2. Y123 (C15) = reselected line from US 15. C37 and C36 = parental lines selected from US 22/3 through US 75. US 15 was selected from R&G Pioneer (Klein) and US 22/3 from R&G Old Type (Klein) germplasm through US 1. Y106 and Y905 are increases of commercial seed lots of R&G Old Type and R&G Pioneer that had been maintained in seed storage since the early 1950's. It is obvious that the initial germplasm base of the CTR, USDA germplasm is highly susceptible to rhizomania. It also appears probable that even though rhizomania was not identified in California until 1983 that lines within our mother root program to improve disease resistance and performance must have been exposed to rhizomania (or Polymyxa betae) for several of the recent cycles of field selections. Conversely, monogerm breeding lines that have primarily been selected for genetic structure (e.g., 546H3 = C562CMS x C546, C718, etc) have remained highly susceptible (see test RZM 185-2 and 185-6) to rhizomania.

TEST RZM 185-4. REACTION OF GERMPLASM INTRODUCTIONS TO RHIZOMANIA, FIELD B, SALINAS, CA, 1985

20 entries x 4 reps, RCB
1-row plots, 16 ft. long

Planted: May 30, 1985
Harvested: November 6, 1985

Variety[1]	Description	Acre Yield[2] Sugar	Acre Yield[2] Beets	Sucrose	Beets/ 100'	Non Suc. SS	Raw J. App. Purity	Tare[4]	Harvest Count	Disease Index[5]
		Lbs	Tons	%	Number	%	%	%	No.	Rating
Y439	Inc Y339	3,822	14.72	12.98	167	3.17	80.3	23.9	26	3.25
N102	F_2(N101 x C37)	2,671	12.95	10.25	117	3.13	76.6	24.6	18	3.42
4209-1	F82-46 x 5942	2,623	12.35	10.45	162	3.22	76.2	36.1	26	3.84
3107-7	PI467875 x PI467869-81	2,556	10.33	12.38	151	3.40	78.4	43.7	24	3.77
3107-1	PI467869 x PI467869-81	2,516	10.08	12.25	181	3.50	77.6	32.5	29	3.63
9961	Inc PI407521 (Russian)	2,499	10.77	11.63	146	2.88	80.1	25.2	23	3.78
5937	Inc Ramonsk 06 (Russian)	2,119	11.30	9.32	175	3.30	73.7	24.1	28	3.79
3107-2	PI467870 x PI467869-81	2,104	7.92	13.07	189	3.45	78.7	38.6	30	3.86
4102	ER-YR-PMR 4N-Z	2,078	9.39	11.13	162	3.03	78.4	37.6	26	3.90
4209-2	F81-37 x 5942	2,056	10.56	9.90	182	3.55	73.4	32.7	29	3.97
F82-36	(82421) Inc C36	1,806	8.68	10.25	179	3.53	74.4	45.7	28	3.87
3107-11	PI467879 x PI467869-81	1,698	7.27	11.82	121	3.22	78.6	53.8	19	3.90
N101	Inc Nem Sel S131	1,584	9.29	8.60	56	3.53	70.8	37.0	9	3.84
9964	Inc PI407528 (Russian)	1,510	9.13	8.10	156	3.65	68.5	44.0	25	3.79
9962	Inc PI407523 (Russian)	1,486	8.98	8.25	139	3.33	71.1	40.6	22	3.97
N103	Inc Nem Sel S147	1,458	6.58	11.00	79	3.47	75.9	41.8	12	3.83
4101	ER-YR-PMR 4N Composite	1,452	8.01	8.90	157	3.40	72.0	38.7	25	3.97
5942	Inc Nem RW 880	1,409	7.81	8.90	123	3.70	70.2	44.2	19	3.76
5940	Inc Pervomaisk 028 (Russian)	1,302	7.26	8.70	165	3.65	70.4	44.3	26	3.65
9963	Inc PI407525 (Russian)	975	6.70	7.32	140	3.92	64.9	26.1	22	3.86
Mean		1,986	9.50	10.26	147	3.40	74.5	36.8	23	3.78
LSD (.05)		687	2.84	1.38	39	NS	5.5	16.6	6	0.5
C. V. (%)		24.4	21.10	9.50	18.7	14.20	5.3	32.0	18.7	11.0
F value		7.4**	4.7**	12.6**	6.2**	1.1NS	4.7**	2.1*	6.2**	2.1*

1/ N101, N102, & N103 = 2N sugarbeet lines that segregate for resistance to cyst nematode from B. procumbens. Released by McFarlance in 1982 from Savitsky's sources. In this and in test RZM 285-11, lines N101, N102, & N103 appeared to segregate for reaction to rhizomania. Roots were either highly susceptible (=C36) or a low frequency of roots showed moderate resistance. These resistant roots were selected and will be progeny tested in 1986. In addition, Savitsky's NR releases will be evaluated in 1986. Tests of B. procumbens and B. patellaris have suggested high resistance or immunity to BNYVV.

5942 = Increase of RW880 wilt resistant (nematode resistant) line from the Netherlands.

3107-1,-2,-7, & -11 = Increases of accessions from China. Individual PI lines were polycrossed to the 12 other PI lines so that these lines represent seed from one PI line outcrossed randomly to all others.

4101 & 4102 = 4N accessions from Europe that have been reselected for multiple disease resistance at Salinas. 4101 was a composite of nine accessions that represented recent pollinator types used in N. Europe.

9937, 5940, 9961, 9963, & 9964 = Increases of accessions from Russia. In a second test (RZM 285-11), 5940 and 5936 (N7776) which were reported to have resistance to cercospora leaf spot were highly susceptible to rhizomania.

Rhizomania literature suggests that an association may exist between resistance to CLS and rhizomania. Except for lines from Italy (Alba) and from some Fort Collins accessions (RZM 185-6) which trace part of their ancestry to Italy (Cessina), this association may not occur. The lines from Beltsville (e.g., SP6822-0), Russia, and China with CLS resistance all appear to be highly susceptible to rhizomania. Our observations and investigations suggest that the CLS-rhizomania resistance association originated with B. maritima germplasm selected for CLS resistance in Italy. Field tests of B. maritima and F_1 hybrids between sugarbeet and B. maritima (RZM 285-11) show that some wild beet types are highly resistant or immune to BNYVV. F_2 and testcross populations will be evaluated in 1986.

2/, 4/, 5/ See footnotes for test RZM 185-1.

TEST RZM 185-5. REACTION OF S^f, MM, A:aa GERMPLASM TO RHIZOMANIA, FIELD B, SALINAS, CA, 1985

12 entries x 4 reps, RCB
1-row plots, 16 ft. long

Planted: May 30, 1985
Harvested: November 6, 1985

Variety[1]	Description	Acre Yield[2] Sugar	Acre Yield[2] Beets	Sucrose	Beets/ 100'	Non Suc. SS	Raw J. App. Purity	Powdery Mildew[3]	Tare[4]	Harvest Count	Disease Index[5]
		Lbs	Tons	%	Number	%	%	Rating	%	No.	Rating
Y439	Inc Y339	5,014	18.88	13.18	154	3.00	81.3	0.7	14.6	24	3.02
Y339H67	2747aa x Y139	3,913	16.76	11.65	164	3.13	78.8	5.0	20.4	26	3.15
3902	Y254H53aa x A	2,772	13.06	10.52	165	2.90	78.2	3.2	27.7	26	3.83
4903A	ER-YR Y246H53(A)	2,677	12.22	11.02	148	3.17	77.5	4.0	25.6	23	3.45
4747	ER-YR-PMR 2747(A,aa)	2,642	12.39	10.65	156	3.45	75.3	5.2	17.0	25	3.46
4904	Inc Y339H67(A)	2,628	12.21	10.85	132	3.28	76.7	4.2	21.5	21	3.45
4903	ER-YR Y246H53aa x A	2,612	12.68	10.38	157	3.17	76.4	4.2	26.6	25	3.65
4905	3218-3221aa x A	2,458	11.42	10.65	179	3.20	76.7	4.0	23.5	28	3.29
4905-2	ER-YR-PMR 2219(A)	2,321	11.09	10.18	142	2.97	77.3	4.0	27.2	22	3.36
4905-3,4	ER-YR-PMR 2220-21(A)	2,259	10.23	10.85	153	3.10	77.5	4.5	20.7	24	3.68
3747	2747aa x A	2,142	11.15	9.57	225	3.50	72.9	4.7	22.4	36	3.68
4905-1	ER-YR-PMR 2218(A)	1,462	7.86	8.38	143	3.08	72.6	2.5	27.1	23	3.71
Mean		2,742	12.50	10.66	160	3.16	76.8	3.8	22.9	25	3.48
LSD (.05)		864	3.30	1.24	38	NS	3.9	2.0	NS	6	0.52
C. V. (%)		21.9	18.40	8.10	16.9	11.60	3.5	36.7	33.3	16.9	10.50
F value		9.1**	6.3**	6.9**	3.1**	1.0NS	3.1**	3.0**	1.2NS	3.1**	1.8NS

[1] See footnote 2 for test 2485.

[2], [3], [4], [5] See footnotes for test RZM 185-1.

RZM 185-6[1/]. EVALUATION OF GERMPLASM LINES TO RHIZOMANIA
SALINAS, CA, 1985

43 entries x 4 replications
1-row plots, 16 ft. long

Planted: May 30, 1985
Harvested: November 7, 1985

Variety	Description	Powd. M. Rating[2/] 9/2	Roots/ Plot No.	Rhizomania Reaction DI[3/]	%R[4/]	0+1[5/] No.
Self-fertile, mm						
4722	ER-YR 2222C1	2.8	21	3.0	11.7	2
4723	ER-YR 2223C1	5.8	25	3.1	19.8	1
F82-546H3	(82460) C562H0 x C546	4.0	25	3.5	8.0	1
3743H0	0740,1,2,4,5H0 x 2741-5	2.8	27	3.5	3.4	0
3755L	0755-S_1(LIYR)aa x A	3.5	28	3.3	9.7	0
4802	ER-YR 2802,3,4	4.0	31	3.2	15.2	2
4755	3755, 3755Z, 3757aa x A	1.8	29	3.3	9.4	0
4756	3755Zaa x A	1.0	31	3.4	9.8	2
4762	Inc. 3212C1	3.0	26	3.6	4.8	2
4767	3217aa x A	3.3	27	3.3	9.5	2
4790	ER-YR 9790	1.8	27	3.3	12.7	0
4790K	2790-S_1(SY)aa x A	3.8	29	3.0	24.2	5
4796A	Inc. C796	3.8	20	3.8	0.0	0
4796H82	3755Zaa x 3796A	4.3	25	3.8	1.0	0
4797	ER-YR 2797	2.3	31	3.6	7.4	0
84-546H31	F82-301H0 x F82-546	4.0	27	3.8	5.0	0
84-546H37	F83-306H0 x F82-546	3.3	27	3.6	4.3	1
84-546H72	83-718H0 x F82-546	3.8	25	4.0	1.1	0
NS-pop-3	Kovacév (31605)	4.5	25	3.9	1.9	1
NS-pop-4	Kovacév (31665)	3.3	28	4.1	1.8	0
Accessions from 1984						
811006H02	FC607 x FC608	4.5	30	3.2	9.5	2
781035H01	FC606CMS	5.3	29	3.1	13.5	2
751105H01	FC506CMS	2.0	30	3.7	1.7	1
781049	FC901	4.8	27	3.3	16.0	2
FC Comp-1[6/]		4.0	28	3.5	11.1	2
FC Comp-2[6/]		4.3	29	3.5	12.0	2
FC Comp-3[6/]		4.8	27	2.8	39.7	8
FC Comp-4[6/]		5.0	30	3.0	20.7	1
A59-1	SLC 15BB_2	5.3	28	3.3	9.7	6
A56-3	GW 359-52R	4.5	21	2.7	36.9	6
A54-6	Midwest 391	5.0	25	3.3	9.5	0
A55-1	US 201	3.0	2	3.2	12.5	0
A69-32	GWmm	5.5	28	3.3	12.8	2
A54-7	Amer #2MM	3.5	15	3.0	20.7	1
Y439	Inc. Y339	1.5	30	2.2	69.9	17
F81-37	Inc. F80-37 (81101)	5.8	28	3.2	9.6	0

RZM 185-6[1]. EVALUATION OF GERMPLASM LINES TO RHIZOMANIA
SALINAS, CA, 1985

43 entries x 4 replications
1-row plots, 16 ft. long

Planted: May 30, 1985
Harvested: November 7, 1985

Variety	Description	Powd. M. Rating[2]	Roots/ Plot	Rhizomania Reaction DI[3]	%R[4]	0+1[5]
		9/2	No.			No.
7225-3	E. Lansing	5.8	28	3.2	12.5	1
35F1-2	E. Lansing	5.3	28	3.8	2.0	0
441239	36DI E. Lansing	5.3	28	3.1	21.0	5
EL 31	E. Lansing	3.0	1	4.0	0.0	0
EL 36	E. Lansing	1.0	24	4.1	1.2	0
EL 40	E. Lansing	0.8	21	3.0	30.7	6
EL 42	E. Lansing	5.0	15	2.7	35.5	3
Mean				3.3		
LSD (.05)				0.6		
C. V. (%)				11.8		
F value				4.1**		

1/ Test 185-6 and 185-7 are continuations of RZM 185-2 thru 185-5, but because of nature of entries and some poor stands, plots were not harvested for yield.

2/ PM not controlled. Scored 0-9 with 0 = resistant. PM ratings appear to be somewhat influenced by rhizomantia with reactions inversely correlated.

3/ Roots scored for rhizomania symptoms on a scale of 0-6 with 0 = no visable symptoms and 6 = dead. DI = disease index or average rating.

4/ %R = % resistant. Roots scored 0-2 considered resistant and 3-6 susceptible to highly susceptible.

5/ 0+1 = total number of roots scored in resistant classes 0-1. Because disease severity was moderate, 0's and 1's were lumped together as 1's. These roots were selected from most of these lines for increase.

6/ FC Comp-# = composite of accessions from Fort Collins (Hecker and Smith). #1 = A54-4 (Amal. A2-9U), A55-4(US 400), A58-4(SLC $15BB_1$), A63-1(UI 112), & A64-4(GW777-60A); #2 = Acc. 2168 (GW74-56C), Acc. 2383(NHM-2, O.P.mm), & Acc. 2475(GW602); #3 = 781084(FC 703), 781066H(FC 705), 811049H(FC 702/7), 821088(Mix Rhizoc. Resist.), & 811056H(FC 709); and #4 = A79-68, 821036H03 (502/3 x FC 607), 821036H0, & 811010H2. In a second evaluation of FC lines, roots with 0-1 scores and negative for BNYVV by ELISA were found in lines A54-6(Midwest 391), A54-7(Amer. 2, O.P.MM), A56-3(GW359-52R), A58-4(SLC $15BB_1$), A59-1(SLC $15BB_2$), A64-4(GW777-60A), Acc. 2168(GW74-56C), Acc. 2475(GW602), FC 703, FC 705, FC 702/7, and FC 709. However, most roots in these lines were visually susceptible and positive for BNYVV. Lines with roots negative for BNYVV corresponded to lines which had individual plants that did not wilt under hot, dry conditions.

RZM 185-7. EVALUATION OF BETA CROPS TO RHIZOMANIA
SALINAS, CA, 1985

19 entries x 1 replication
1-row plots, 16 ft. long

Planted: May 30, 1985
Harvested: November 7, 1985

Description	PM 9/12[1/]	Plants Per Plot	DI RZM[1/]	% Resist[1/]	No. 0+1[1/]
Swiss Chard					
Burpees' Rubarb Chard	0	20	4.0	0.0	0
Burpees' Fordhook Giant Chard	0	19	3.9	0.0	0
Northrup King Fordhook Giant	4	20	3.5	10.0	0
Bentley Green Lucullus	0	19	4.7	0.0	0
Ferry-Morse Large Ribbed Dark Green	4	28	3.2	14.3	1
Iso 35	0	24	3.3	0.0	0
Red Beet					
Ferry-Morse Tall Top Early Wonder	0	29	3.6	10.3	0
Ferry-Morse DDR	3	25	4.0	0.0	0
Bentley DDR	4	32	3.4	6.3	1
Germains DDR	0	19	3.7	0.0	0
Burpee Red Ball	0	23	4.0	0.0	0
Northrup King Ruby Queen	0	30	4.0	0.0	0
Fodder Beet					
Fr 2 Rose Des Ardennes	2	1	3.0	0.0	0
Fr 4 Geante Rouge	0	2	4.5	0.0	0
Famille O Dutch Fodder Beet	4	30	3.5	9.1	0
Famille R German Fodder Beet	5	28	2.8	25.0	3
Mammoth Long Red	0	33	3.1	12.1	0
Giant Yellow Intermediate	4	8	3.6	0.0	0
Oscar	3	18	3.4	11.1	0

[1/] See footnotes for Test RZM 185-6.

TEST RZM 285. EVALUATION AND SELECTION FOR RESISTANCE TO RHIZOMANIA, 1985

Test RZM 185 was planted May 30, 1985 in field B at the U.S. Research Station. The primary purposes of RZM 185 were to develop evaluation and selection techniques, to verify the reaction of corresponding hybrids in California to that reported elsewhere, and to identify sources of genetic variability for host-plant resistance to rhizomania. Test RZM 285 was planted July 23, 1985 in field A. RZM 285's primary purposes were to reevaluate breeding lines that appeared to possess resistance in tests in 1984 or in RZM 185, to evaluate progeny families and lines derived from roots selected in 1984, and to select among and within potential sources of resistance. A late planting date was necessitated by having to wait for seed produced on plants that were selected in 1984.

For test RZM 285, the procedure was similar to that used for RZM 185. A plot area 80 beds (rows) wide was treated with rhizomania infested soil and seed was sown into the treated area. Temik was used to minimize the effects of nematodes. A frequent watering schedule with sprinklers was used to promote uniform and as severe disease as possible. Except for an area used for test RZM 285-11, this plot area had not been in sugarbeet for 4 years. During this time globe artichoke had been grown. The area used for 285-11 was originally set up to field test for reaction to nematodes. Rhizomania was discovered in this area in 1983. In 1984, a preliminary evaluation of sugarbeet germplasm and Beta species was grown and rhizomania development was severe.

In the test area that had been in artichokes, disease development was relatively mild. A combination of newly infested soil and lateness of the season did not appear to allow the plants sufficient time or exposure to develop as severe symptoms as in test RZM 185 or in a similar July planted test in 1984. However, randomly selected plants throughout this area from about 6 weeks onward showed high and uniform levels of infection by BNYVV when assayed by ELISA.

The late planting date, relatively mild early infection, and very late harvest from cold, wet soils minimized the root symptoms. Disease indices were low and differences among lines were small. However, a combination of canopy scores (wilting, vigor, & color) and root symptoms at harvest permitted what appeared to be reliable estimations of host-plant reaction to rhizomania. Wilting ratings made in early October under dry, hot (30-35°C) atmospheric conditions gave good associations with known line reactions to rhizomania. Under these conditions, highly susceptible entries such as US H11 were uniformly given ratings of 4-5 on a scale of 1 to 5 where 1 = no wilting and 5 = severe wilting. Highly resistant lines such as B. maritima WB 42 and Holly's experimental resistant lines were rated 1's or segregated on an individual plant basis from 1 to 5. Entries such as Rizor and Mono 1167 were usually intermediate.

Because of the late harvest under cold, wet, and muddy conditions, root symptoms were also somewhat obliterated by mud and all roots more-or-less looked the same. Also by December, the bearding on the roots appeared less severe in development than had been observed earlier. However, using a combination of wilting scores, root symptoms (both bearding and internal vascular colora-

tion), and to a limited extent assays by ELISA for BNYVV, selections for resistance were made in a wide range of germplasm.

Despite the moderate symptoms expressed in test RZM 285, we think that one successful, complete cycle of selection for resistance can be made per year, especially after a field plot area is developed that has a high level of infestation. To achieve one cycle of selection per year, our program will have the following approximate schedule:

- plant in infested soil about July 1-15,
- evaluate visually from Sept. 1 - Oct. 15,
- harvest, score & select plants on the basis of root and top symptoms about Nov. 15 - Dec. 1,
- induce selected roots in cold room from Dec. 1 - April 1, and/or grow stecklings from remnant seed in Oregon from August 1 - March 1, and
- produce seed in greenhouse and isolation chambers from April 1 - June 30.

This schedule will accomodate both mass selection on an individual plant basis and progeny testing (recurrent selection) with or without yield performance data.

Test RZM 285 was divided into 11 subtests depending upon the type of germplasm and the intent for evaluation and selection. These subtests will be briefly discussed:

RZM 285-1: Entries from a cooperator were evaluated and resistant roots from within segregating lines were selected by the cooperator. Data on segregation ratios were provided to us for possible genetic analysis.

RZM 285-2: Observation and evaluation of hybrids, O.P. lines, "tolerant" accessions, etc., were made. Entries were nearly a duplication of tests RZM 185-2 & 185-3. Although disease development was less severe, the disease indices paralleled those for 185-2 & 185-3.

RZM 285-3: Wilt resistant line RW 880 from the Netherlands and F_1 and F_2 populations between RW 880 and C37 and C46 were evaluated under rhizomania conditions. On the basis of wilting severity, there was evidence that the wilting resistant factor(s) that are known to operate under nematode infected conditions also protected against wilting in this test. RW 880 and individual F_2 plants showed considerably less wilting than did C37 and C46. However, based upon root symptoms and size, all lines appeared to be equally susceptible to rhizomania. It was a "long-shot" hunch that the B. maritima source of the wilt-resistant factor in RW 880 may be associated with resistance to rhizomania. These lines and populations will be reevaluated in 1986 under more severe conditions.

RZM 285-4: S_1 progeny evaluation could be useful to select and find homozygous sources of resistance to rhizomania. Seventy-two S_1 progeny families from MM, S^f, A:aa population-904 were evaluated. No progeny family with high resistance was found. But, based upon wilting scores, root symptoms, overall canopy appearance, and root size, individual roots were selected for seed production from within the most promising families.

Self-fertile, random-mating, monogerm populations 790K and 743 appeared to have variability for reaction to rhizomania in preliminary tests. Strips of these popns were grown and resistant plants selected for seed production. Cycle 1 synthetics and progeny families will be evaluated for improvement in 1986.

RZM 285-5: In 1984, accessions obtained from Hecker and Smith at Fort Collins, CO were composited and evaluated for reaction to rhizomania. A low frequency of plants within these bulks appeared to be resistant and were selected. These selected plants were crossed to both multigerm and monogerm breeding lines in 1985 and their F_1's were evaluated elsewhere in this series of tests in 1985. Early observations in test RZM 185-6 again suggested that some of these accessions in the composites may be resistant. To determine which specific lines were contributing this resistance, individual FC accessions were grown (see table on following page). Within these lines, reactions to rhizomania appeared to fall into somewhat discrete classes based upon wilting and root scores. Most plants within all lines were highly susceptible but a low frequency of plants did not wilt and were negative to BNYVV when assayed by ELISA. The possibilities that some or all of these are escapes have not been eliminated.

RZM 285-6: Individual plants from selections made in 1984 were crossed to C46, C37, and popn-747 in the greenhouse in 1984-85. The selected roots were from within bulked accessions and the exact sources are unknown. Twenty-four F_1 lines in two replications were evaluated in test RZM 285-6. On the basis of wilting and root symptoms, plants within these F_1 lines appeared to fit into more-or-less discrete classes: some were all resistant, some segregated, but most were all susceptible. On the basis of wilting and root symptoms, the best plants were selected from the best lines. Samples of field selected roots were evaluated by ELISA for BNYVV and most were found to be negative. The elite plants from these selections are being used in crosses to lines with adaptation to California. These backcrosses will be evaluated and reselected in 1986.

RZM 285-7: Plants that appeared to be resistant to rhizomania from a 1984 selection block (same source as for RZM 287-6) were crossed to monogerm populations to produce F_1 lines. These F_1 lines were evaluated in test RZM 285-7. Again, on the basis of wilting and root symptoms, individual plants were selected from within the best lines. A sampling of these selected roots by ELISA for BNYVV again showed most to be negative. These selected plants are presently being backcrossed to susceptible monogerm populations and lines. These backcrosses will be evaluated in 1986 and reselected. Efforts will be continued to establish resistance (tolerance) in both multigerm and monogerm populations with adaptation to the western USA. That is, resistance to rhizomania will be combined with resistance to curly top, virus yellows, bolting, etc., with a productive background, and with readily useable genetic structure.

RZM 285-8: Half-sib progeny families from roots selected in 1984 were evaluated. Selected roots were from diverse sources that included lines 70026PL and 64308PL from Alba. Whereas, susceptible checks US H11 and C37 were rated as 4-5 for wilting and had moderate root bearding, most of these half-sib

Test RZM 285-5. Evaluation of accessions from Fort Collins (Hecker and Smith) for reaction to rhizomania.

Variety	Description	Wilt Score[1]	No. Roots Selected[2]	No. Roots Negative for BNYVV[3]
A54-4	Amal. A2-9U; O.P. MM	3-5	0	
A54-6	Midwest 391; O.P. MM Holly	2-5	4	3/4
A54-7	Amer. 2; O.P. MM ACS	4	2	1/2
A55-4	US 400	3-5	0	
A56-3	GW359-52R; O.P. MM GW	3-5	6	4/6
A58-4	SLC $15BB_1$	2-5	3	2/3
A59-1	SLC $15BB_2$	1-5	3	2/3
A60-2	Amer. #2; O.P. mm	3-5	0	0/1[4]
A63-1	UI 112; O.P. MM	5	0	
A64-4	GW777-60A; O.P. mm	1-5	4	4/4
Acc 2168	GW674-56C; O.P. MM	2-5	4	3/4
A69-32	GW O.P. mm	2-4	0	0/1[4]
Acc 2383	NHM-2; O.P. mm National SC	3-5	0	
Acc 2475	GW 602; O.P. MM	1-4	4	4/4
821036H03	FC 502/3 x FC 607, LSR	2-5	0	
831036H07	FC 504 x FC 607, LSR	3	0	
811010H2	FC 607 x 761016H, LSR	4	0	
811012H03	(FC 605 x 502/2) x 761036H0, LSR	3-5	0	
781084	FC 703, Rhizoc. R.	3-4	4	3/4
781066H	FC 705, Rhizoc. R.	1-4	7	6/7
811049H	FC 702/7, Rhizoc. R.	3-5	3	2/3,0/1[4]
821088	Mix of 3 Rhizoc. R.	3-5	4	3/4
811056H	FC 709, Rhizoc. R.	1-4	6	5/6

[1] 1 = no wilting to 5 = severe wilting. Scored 10/1/85. 3-5 gives range of wilting for individual plants on a plot basis, most roots in 4-5 class for all entries.

[2] Number of roots selected from field plot that were free of rhizomania root symptoms. Roots selected 12/11/85.

[3] Ratio of roots from field selected groups that were negative to BNYVV by ELISA tests. ELISA by Dale Huss in Dr. Duffus' lab. Lower tap root sampled twice per root.

[4] Susceptible checks. .Roots with rhizomania symptoms.

families were rated 1-3 for wilting and under the conditions of this test had very mild root symptoms. Plants from within the best progeny families were selected to produce the cycle 2 synthetic of this population. The cycle 2 synthetic and cycle 2 half-sib families will be evaluated and reselected under more severe conditions in 1986.

RZM 285-8: Half-sib progeny families from roots selected in 1984 were evalu-

ated. Selected roots were from diverse sources that included lines 70026PL and 64308PL from Alba. Whereas, susceptible checks US H11 and C37 were rated as 4-5 for wilting and had moderate root bearding, most of these half-sib families were rated 1-3 for wilting and under the conditions of this test had very mild root symptoms. Plants from within the best progeny families were selected to produce the cycle 2 synthetic of this population. The cycle 2 synthetic and cycle 2 half-sib families will be evaluated and reselected under more severe conditions in 1986.

RZM 285-9: In 1984 trials, breeding line Y47 appeared to segregate for tolerance to rhizomania. Half-sib progenies from selected roots were evaluated in test 285-9. From within the most resistant families, individual beets were selected in Dec., 1985. The cycle 2 synthetic and half-sibs will be evaluated and reselected in 1986. The rate of progress for resistance to rhizomania in this and other cycle 1 and 2 synthetics will be determined.

RZM 285-10: The most tolerant line observed within the USDA project at Salinas in 1984 was Y39. From a selection block under moderate rhizomania conditions in 1984, roots that appeared to be resistant were selected and increased in bulk and as full-sib and half-sib families. These cycle 1 synthetic and progeny families were replicated up to four times in this test. Among the 100 entries were eight full-sib families that were derived from roots that were free from symptoms and negative to BNYVV by ELISA. On the basis of wilting scores, all of these entries were susceptible to rhizomania with wilting scores ranging from 2-5. However, on the basis of root symptoms, disease development was very mild and in some cases roots appeared to be free of bearding and have normal tap root and feeder root development. Rhizomania would not have been detected in some lines if these plots were not in a known rhizomania infested field. Even though most of this test was grown under mild disease conditions, the test overlapped into the rhizomania plot area used in 1983 and 1984. Even in this area, disease expression remained mild among most families. Because root symptoms across this whole test area were relatively mild and disease indices fell into a very narrow range, it was not possible to correlate symptoms of roots from the 1984 selection with their performance in progeny families in this test. Plants from within the cycle 1 bulks and progeny families were selected in Dec., 1985 and cycle 2 seed will be produced in June of 1986.

These new progeny families and cycle 2 synthetics will be evaluated in 1986 in comparison to the source line Y39 and cycle 1 synthetic. It appears, however, that unless more severe rhizomania conditions occur, it will be difficult to detect visually additional increments of host-plant resistance than that now shown by these Y39 progeny lines. It may become necessary to add sugar yield performance under diseased conditions as part of the selection criterion to make further progress.

RZM 285-11: Test RZM-11 was grown in the plot area known to be infested with rhizomania at least since 1983. The 1984 trial in this area was severely damaged by rhizomania. Even though originally set up as a nematode test plot, cyst nematode infection appeared to be minimal and have little influence on beet growth. It is suspected that this area originally became infested with rhizomania when soil was brought in from growers' fields to establish high nematode populations. Because of the history of severe rhizomania in this

area, it was chosen as the best site to challenge B. maritima and other lines that may have resistance.

US 201, that has been reported to be tolerant, was moderately to highly susceptible. Coe's SP82320-02, that had its CMS derived from B. maritima was highly susceptible and severely damaged, as were two Russian accessions with CLS resistance, 5936 (N7776) and 5940 (640 Perv. 028). SLC3mm and SLC15mm were highly susceptible in this test. The nematode-resistant releases N101, N102, & N103 were mostly highly susceptible but a low frequency of plants appeared to be moderately resistant. Yellow wilt resistant monogerm line 84W126 was moderately to highly susceptible.

The majority of this plot involved tests with B. maritima lines that had previously been identified as being resistant and crosses between resistant B. maritima plants from lines WB41, WB42, & WB318 and highly susceptible sugarbeet line C37. B. maritima lines WB41 & WB42 and accessions 5967 & 5968 that originally were received from Dr. Viggo Lund and collected from the Kalunborg Fjord area of Denmark were all highly resistant. WB318, collected by Dr. F. Cochec from Kermangen, Brittany, was moderately to highly resistant. F_1 lines between plants of WB41, WB42, & WB318 that had been selected for resistance and negative to BNYVV by ELISA in 1984 and C37 were uniformly resistant within lines. However, differences between F_1 lines were observed. The F_1 hybrids between WB42 and C37 were the most resistant based upon wilting, canopy scores, and root symptoms. F_1 hybrids between WB318 and C37 were the most variable. From each set of F_1 crosses, the most resistant F_1 line was selected and individual plants from within these lines were tested by ELISA for BNYVV. The plants that were negative were saved for seed production. These selected F_1 plants will be used to produce F_2 and backcross populations for genetic analyses and to transfer this resistance to sugarbeet.

Summary of test RZM 285: Compared to the difficulties experienced in the USA to find genetic variability for resistance to curly top virus, virus yellows, cercospora leaf spot, Rhizoctonia, cyst nematode, etc., the situation for developing resistance to rhizomania appears to be much better. Although the majority of the CTR, VYR germplasm base is highly susceptible to rhizomania, sources of tolerance and resistance have been identified and appear to be transferable in the near future to germplasm lines, parental lines, and hybrids with adaptation to the USA. Techniques have been developed at Salinas whereby a complete cycle of selection (seed to seed) can be completed in one year. Uniform test plots (RZM 185) can be established by infesting field plot areas, growing one or more beet crops, and carefully controlling irrigation and other cultural practices. Genetic variability for host-plant reaction appears to be present from a number of diverse sources. Among these sources are tolerance or resistance within the ongoing breeding program, e.g., within Y39 (tests RZM 185 and RZM 285-10); resistance or tolerance from lines accessed from Europe, e.g., from Alba; high resistance from germplasm developed in Colorado by Great Western and USDA (tests RZM 185-6 & RZM 285-5); high resistance or immunity to BNYVV from some lines of B. maritima (RZM 285-11); and resistance or immunity of the type currently found in certain Holly Sugar Co. experimental breeding lines and hybrids (RZM 185-2). The genetic mechanisms between these sources appear to differ. Dominant gene(s) with major effects appear to condition resistance within B. maritima (RZM 285-11) and Holly's sources. Reaction within Y39 and European sources

appear to be quantitative and additive. The genetic nature of resistance in other sources, e.g., from the FC accessions (RZM 185-6 and RZM 285-5) has yet to be determined. With the present breeding material and knowledge, the breeding program at Salinas will be designed to establish both multigerm and monogerm breeding populations with different types of genetic variability for resistance. Cycle 2 selections have been made and will be evaluated in 1986. Attempts will be made to convert the most important lines in our germplasm base to rhizomania resistant or tolerant sorts. The intermediate goal will be to have multiple disease resistant germplasm (resistance to rhizomania, curly top, virus yellows, bolting, Erwinia, powdery mildew, etc.) so that the immediate need for rhizomania resistance will not be a continuing impediment to the ongoing genetics and breeding program.

Acknowledgement: We wish to acknowledge the help of Dale Huss for ELISA determinations; Chris Hoffman, Roy Anderson & Mike Arii for making the crosses, disease scores, harvest, and data analyses; Chet Kiaha for growing the field plots; and Lu Torres & Marlene McQueen for typing and editing the summary tables and Salinas report.

SUGARBEET RESEARCH

1985 Report

Section B

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Dr. R. E. Wyse, Plant Physiologists

Cooperation:

Utah Agricultural Experiment Station

The research was supported in part by funds provided through the Beet Sugar Development Foundation (Project 64).

Final data are not available since the research is still in progress. Final results will be published in the 1986 Sugarbeet Research Report.

SUGARBEET RESEARCH

1985 Report

Section C

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PUBLICATIONS

Abstracts of Papers Published or Approved for Publication and Germplasm Registrations.

CISTUE, L., I. ROMAGOSA, T. TSUCHIYA, J. M. LASA, and R. J. HECKER. Primary trisomics in sugar beet: II. Cytological identification. Crop Sci. Approved for publication.

All nine types of sugar beet primary trisomics were cytologically identified by means of somatic karyotype analysis. Not all extra chromosomes could be identified at metaphase with certainty because of their similarity in size and arm ratio. Somatic prophase analysis was found useful in confirming the results of metaphase analysis of the extra chromosome present in some trisomic types.

HECKER, R. J. Potential of biotechnology for better sugarbeet varieties. Sugar Producer. Feb. 1986. In press.

Potential applications of new biotechnologies to sugarbeet were reviewed. Cloning techniques are fairly well developed and are being used to a limited extent. Callus and cell culture and plant regeneration techniques are in process of development; they offer great promise as breeding tools. DNA transfer is the ultimate biotechnology, but it is not yet possible in sugarbeet.

HECKER, R. J. and E. G. RUPPEL. 1986. Registration of Rhizoctonia root rot resistant sugarbeet germplasm FC 712. Crop Sci. 26:213-214.

Sugarbeet germplasm FC 712 was developed, released, and registered by USDA-ARS. FC 712 is a new germplasm that is resistant to root rot caused by Rhizoctonia solani. It is diploid and multigerm. FC 712 was developed and released for use as a pollinator or as a source germplasm for development of pollinators in the breeding of Rhizoctionia-resistant hybrid cultivars by sugarbeet breeders.

HECKER, R. J., P. C. STANWOOD, and C. A. SOULIS. Storage of sugarbeet pollen. Euphytica. Approved for publication.

To develop the technology for long-term pollen preservation, sugarbeet pollen collected from plants grown in the greenhouse and in the field was stored from 1 day to 1 year at 5, -18, and -196 C (liquid N). To survive freezing, the pollen had to have less than 18% moisture. Pollen desiccated to 12% moisture or less was successfully stored at -196 C for up to 1 year. It effected fertilization of male sterile flowers virtually as well as freshly collected pollen. The germination of the resulting seed was good and not different than seed from fresh pollinations. Pollen was preserved slightly less well at -18 C for 1 year. One year at 5 C was essentially lethal. In vitro pollen germination served as a poststorage viability measure, provided the pollen was hydrated prior to germination. The methods tested in these experiments provide a relatively simple, reliable,

and inexpensive means of preservation of sugarbeet pollen for breeding purposes or for preservation of genetic resources.

MARTIN, S. S. 1985. Inhibition and activation of the polyphenol oxidase of Beta vulgaris. Phytochem. Soc. N. Am. Newsletter 25(2):P18. (Abstr.)

Empirical tests previously identified 2-mercaptoacetic acid (2-MAA) as an effective inhibitor of sugarbeet polyphenol oxidase (E.C. 1.10.3.1). With isolated PPO acting on tyrosine substrate, 1.8 X 10^{-3} M 2-MAA resulted in complete inhibition during a 60 min. reaction time. A lag phase for PPO-catalyzed tyrosine hydroxylation occurred when no exogenous reductant was supplied; the presence of H_2O_2 or DOPA eliminated the lag. In contrast to results for some plant PPOs, sodium dodecyl sulfate (0.1% in a reaction mixture containing tyrosine, buffer, and PPO) revealed no latent forms of sugarbeet PPO.

ROMAGOSA, I., R. J. HECKER, T. TSUCHIYA, and J. M. LASA. 1986. Primary trisomics in sugar beet: I. Isolation and morphological characterization. Crop Sci. 26: In press.

Nine sugarbeet (Beta vulgaris L.) primary trisomic types were established from a total of 48 trisomic plants isolated in the progeny of autotriploids of annual and biennial types of the inbred NB1. Based on morphology, 42 of these trisomic plants were classified into eight morphologically distinct groups. Cytological identification of the extra chromosome of these eight groups and of the ninth type was accomplished by karyotype analysis in somatic cells. Ten leaf and petiole measurements were taken on 3- to 4-month-old plants. Although significant differences existed among diploid and trisomic types, and any two trisomic types differed by at least three variables, no single trait could distinguish more than four trisomic types. Discriminant analysis was performed on leaf measurements for seven trisomic types and their diploid sibs. It was found that the discriminant functions classified most plants (97%) correctly within a given environment. However, the value of the measurements depended on the specific environment. This fact precludes the use of the same discriminant functions for classification purposes over a series of different environments, although these functions might be useful in a standard controlled environment.

RUPPEL, E. G. and R. J. HECKER. 1985. Control of rhizoctonia root rot in sugarbeet with single pre-layby applications of experimental fungicides. Phytopathology 75:1308. (Abstr.).

Quasi-commercial conditions were established in a field heavily infested with Rhizoctonia solani (AG-2) to determine if pre-layby applications of experimental fungicides could control rhizoctonia root rot of mature sugarbeet. Beets were planted 19 April 1984, and fungicides were banded in crowns at the cotyledon stage, the four- to six-leaf stage, or just before plants covered the furrows. Roots were harvested and evaluated for rot and yield on 13 October. Single applications of pencycuron 75WP (NTN 19701; 40 g ai/305 m row), triadimefon 50WP (14 g ai/305 m row), and triadimenol

25DF (14 g ai/305 m row) reduced disease severity 16-54%, and increased root yield 15-77% and sucrose content 11-26% in a susceptible but not a resistant commercial cultivar. Disease control resulted in a gross return of $220-593/ha. None of the fungicides currently is registered for control of rhizoctonia root rot in sugarbeet.

SMITH, G. A. 1986. Sugarbeet. Book Chapter in Fehr, W. R. (ed). Handbook of Plant Breeding: Crop Species. Macmillan, New York. Accepted for publication.

This chapter includes a detailed description of breeding methods used in the U.S. and Europe for breeding line development and for commercial hybrids. Subject matter covered also includes the following: Extent and nature of breeding programs, breeding objectives for cultivar development (including disease resistance for all major diseases), steps in cultivar development, sources of genetic variability, field plot techniques for genotype evaluation, procedures for seed production, and future prospects for cultivar development including in vitro sporophytic-gametophytic screening and cloning.

SMITH, G. A. 1986. Sporophytic screening and gametophytic verification of phytotoxin tolerance in sugarbeet (Beta vulgaris L.). Book chapter in Mulcahy, D. L. (ed). Biotechnology and Biology of Pollen. Springer Verlag, New York. Accepted for publication.

This chapter describes the techniques we have developed for in vitro identification of genotypes tolerant to herbicides or pathotoxins such as CBT and cercosporin. The association between in vitro selection in the sporophytic and gametophytic generations is discussed along with data from some of our research.

SMITH, G. A. and E. G. RUPPEL. 1986. Registration of tetraploid Cercospora resistant sugarbeet germplasm. Crop Sci. 26: Accepted for publication.

Sugarbeet germplasms FC 606 (4x), FC 606 (4x) CMS, FC 607 (4x), and FC 607 (4x) CMS were developed, released, and registered by USDA-ARS. These germplasms are tetraploid, monogerm lines with high combined resistance to Cercospora beticola and curly top virus. They were developed as parental lines for synthesis of triploid (3x) hybrids.

SNYDER, F. W. and G. A SMITH. 1986. Heritability of taproot weight:leaf weight ratio in sugarbeet. J. Amer. Soc. Sugar Beet Technol. Accepted for publication.

Two cycles of selection for low and for high taproot to leaf weight ratio (TLWR) were made in 10-leaf-stage sugarbeet seedlings. Heritabilities of TLWR determined with standard units and parent-progeny regression were 0.90 and 0.91 for the first and second cycle, respectively. Each group of selected parental plants produced polycrossed seed, which was used for

progeny testing. The high-TLWR progenies had significantly greater root weights and recoverable sucrose per hectare than the low-TLWR progenies.

Papers Published Since Abstracted in Previous Report.

RUPPEL, E. G. 1985. Susceptibility of rotation crops to a root rot isolate of Rhizoctonia solani from sugarbeet and survival of the pathogen in crop residues. Plant Dis. 69:871-873.

SMITH, G. A. and H. S. MOSER. 1985. Sporophytic-gametophytic herbicide tolerance in sugarbeet. Theor. Appl. Genet. 71:231-237.

WILEY, R. B., E. E. SCHWEIZER, and E. G. RUPPEL. 1985. Interaction of kochia (Kochia scoparia) and Rhizopus sp. on sugarbeet (Beta vulgaris) germination. Weed Sci. 33:275-279.

CERCOSPORA/CURLY TOP RESISTANCE BREEDING AND RELATED RESEARCH (BSDF PROJECT 25)

1985 Cercospora Field Research.--G. A. Smith and E. G. Ruppel.

The 1985 Cercospora field research supported by BSDF Project 25 was conducted for the fourth year on Colorado State University land located just west of the CSU veterinary research and teaching center. The leaf spot nursery was planted April 16. Planting was followed by intermittent rain through May 13. Final stands were very good. Precipitation continued through June, and moderate hail damage occurred June 3. The nursery was inoculated twice, on July 3 and 10. Conditions for disease development were considered ideal throughout the summer. The epiphytotic peaked about August 22. Preliminary evaluations were conducted on August 15 and final evaluations on August 22. On August 22, the mean leaf spot ratings of all susceptible and resistant checks were 7.0 and 4.1, respectively. These values compare with 7.2 and 3.8 for susceptible and resistant checks, respectively, in 1984.

Breeding for Resistance to Cercospora and Curly Top Virus 1985.--G. A. Smith and E. G. Ruppel.

Seventy eight entries were evaluated in the breeding line nursery in 1985. The severe leaf spot epidemic resulted in a resistant check reading of 4.0 and a susceptible check reading of 8.0. Entries in the breeding nursery, as with all other tests in the nursery, are bordered on all sides by a susceptible spreader. The results from our breeding nursery tests for 1985 are presented in Table 1.

Eighteen of the 78 entries were equal to or better in resistance than the resistant check (entry 1616). Most of the resistant entries, which rated either 3.2, 3.5, or 3.8, had FC 605, FC 606, or FC 607 as one of

Table 1. Mean leaf spot ratings of some breeding lines and other entries at Fort Collins, Colorado, 1985.

Entry no.	Seed no.	Description	Leaf Spot[1]
1540	821097H0	FC 607 (4x) T.O. C_2	3.5
1541	821097H01	FC 607 (4x) CMS C_2	3.8
1542	841040H0	FC 607 (4x) T.O. C_3	4.5
1543	841040H01	FC 607 (4x) CMS C_3	4.2
1544	841042H0	FC 606 (4x) T.O. C_3	5.8
1545	841042H01	FC 606 (4x) CMS C_3	5.2
1546	841008H0	FC 606 (4x) T.O. C_4	5.5
1547	841008H01	FC 606 (4x) CMS C_4	4.5
1548	821039H06	FC 506 CMS X FC 606 T.O.	3.5
1549	821041H02	FC 605 CMS X FC 502/3 T.O.	4.2
1550	821041H06	FC 506 CMS X FC 502/3 T.O.	4.2
1551	791015H02	FC 605 CMS X FC 502/2 T.O.	3.8
1552	791015H04	(652016 s1 CMS X FC 605)X FC 502/2 T.O.	4.0
1553	791019H04	FC 502/2 CMS X 661153H0;642027s1 = FC 603 T.O.	4.8
1554	821050H08	662119 s1 CMS X SP 6322-0 MM	4.5
1555	821057H3	FC 504 CMS X Spanish LS "Tolerant" 4x	4.8
1556	811004H04	FC 606 CMS X SP74564-0 T.O., mm	4.8
1557	811006H02	FC 607 CMS X FC 608 T.O.	4.5
1558	811011H02	FC 506 CMS X 761036H0 mm, 662110s1 T.O.	4.2
1559	811011H04	(662119s1 CMS X FC 605 T.O.) X 761036H0 mm	4.0
1560	811012H03	(FC 605 CMS X 502/2 T.O.) X 761036H0 mm	4.5
1561	811012H07	FC 502/3 CMS X 761036 H0 mm	4.2
1562	811015H02	662119s1 CMS X FC 605 T.O.	4.2
1563	A78-45	FC 606 CMS, 2x, O.R.	3.8
1564	A78-44	FC 606 T.O., 2x, O.R.	4.8
1565	A79-67	FC 607 T.O., 2x, O.R.	4.2
1566	791013H03	FC 502/3 CMS X FC 605 T.O. mm	3.8
1567	791013H04	662119s1 CMS X FC 605 T.O. mm	4.8
1568	791016H03	FC 606 CMS X FC 502/3 T.O.	4.0
1569	791019H06	(652016s1 CMS X FC 605) X 661153H0	3.8
1570	751102H05	FC 506 CMS X FC 605 T.O.	3.8
1571	832028H04	FC 607 CMS(sel) X FC 506 T.O.	4.5
1572	831029H02	662119s1 CMS X FC 607 T.O., O.R.	4.8
1573	831029H04	(652016s1 CMS X 662119s1 T.O.) X FC 607, T.O., O.R.	4.5
1574	831030H03	(FC 605 CMS X FC 502/2 T.O.) X FC 607, T.O., O.R.	3.8
1575	831030H04	761025H01 CMS (B_3) X FC 607 T.O., O.R.	4.2
1576	831030H05	FC 605 CMS X FC 607 T.O., O.R.	3.5
1577	831032H03	(FC 605 CMS X FC 502/2 T.O.) X FC 606, T.O., O.R.	3.8
1578	831033H03	FC 605 CMS X 761036H0	4.0
1579	831034H2	(FC 605 CMS X 502/2 T.O.) X SP6322-0 MM	3.5
1580	831034H3	(FC 605 CMS X 761036H0) X SP6322-0 MM	3.8
1581	831034H4	761036H01 CMS (B_3) X SP6322-0 MM	4.2
1582	831034H7	(FC 606 CMS X FC 502/2 T.O.) X SP6322-0 MM	4.0

Table 1. Continued.

Entry no.	Seed no.	Description	Leaf Spot[1]
1583	831038H02	FC 607 CMS (sel) X FC 502/3 T.O.	4.0
1584	831038H03	FC 605 CMS X FC 502/3 T.O.	3.2
1585	831042H02	FC 607 CMS 2x X FC 607 T.O. 4x (C_2)	4.0
1586	831047	Chinese Acc. PI 467871	5.2
1587	841009H0	FC 609 T.O.; 504 T.O. X 502/2 T.O. X 662119s1 T.O.	5.0
1588	841009H01	FC 609 CMS; (504 CMS X 502/2 T.O.) X 662119s1 T.O.	5.2
1589	841039H02	FC 607 CMS X SP6323-0 T.O. mm	4.5
1590	841039H03	(622112CMS X 622119s1 T.O.) X SP6323-0 T.O. mm	5.0
1591	841039H04	FC 502/3 CMS X SP6323-0 T.O mm	4.2
1592	841044H02	FC 607 CMS X FC 603 T.	4.8
1593	841044H03	(622112 CMS X 622119s1 T.O.) X FC 603 T.O.	4.8
1594	841048H	Composite cross Greek lines HS1, 301, 501, 101 4x	6.8
1595	A84-11	P.I. #467869 X 467869 through 81 Pollycross,MM	5.0
1596	A84-12	P.I. #467870 X 467869 through 81 Pollycross,MM	4.5
1597	A84-13	P.I. #467871 X 467869 through 81 Pollycross,MM	5.2
1598	A84-14	P.I. #467872 X 467869 through 81 Pollycross,MM	5.0
1599	A84-15	P.I. #467873 X 467869 through 81 Pollycross,MM	5.5
1600	A84-16	P.I. #467874 X 467869 through 81 Pollycross,MM	6.0
1601	A84-17	P.I. #467875 X 467869 through 81 Pollycross,MM	5.8
1602	A84-18	P.I. #467876 X 467869 through 81 Pollycross,MM	5.5
1603	A84-19	P.I. #467877 X 467869 through 81 Pollycross,MM	5.5
1604	A84-20	P.I. #467878 X 467869 through 81 Pollycross,MM	5.0
1605	A84-21	P.I. #467879 X 467869 through 81 Pollycross,MM	5.2
1606	A84-22	P.I. #467880 X 467869 through 81 Pollycross,MM	5.5
1607	A84-23	P.I. #467881 X 467869 through 81 Pollycross,MM	5.5
1608	A84-24	P.I. #452434 Thien Yen #3	4.8
1609	A84-25	P.I. #452435 Thien Yen #4	5.0
1610	A84-26	Chinese NS-358(C_1)2N, MM, OP from Novi Sad	5.0
1611	A84-27	Chinese NS-359(C_2)2N, MM, OP from Novi Sad	4.5
1612	A84-28	Chinese NS-C3(42 X 55) MM, OP from Novi Sad	5.8
1613	A84-29	Chinese NS-C4 (B-63) MM, OP from Novi Sad	6.0
1614	A84-30	Chinese NS-C5 (B-16) MM, OP from Novi Sad	5.0
1615	A84-31	Chinese NS-C6 (41 X 20) MM, OP from Novi Sad	6.2
1616	811008H6	LSR check	4.0
1617	771056H	LSS check	8.0
	LSD(.05)		0.7

[1]Leaf spot ratings based on 0-10 scale, with 0 = no symptoms and 10 = complete defoliation.

their parental components. Entry numbers 1595 through 1609 were polycrosses of Chinese P.I. numbers. Entries 1610-1615 were accessions of Chinese germplasms that were obtained through Novi Sad, Yugoslavia. Several of these entries have moderate leaf spot resistance. The Cercospora, Erwinia, and powdery mildew evaluations of the original P.I. numbers and polycrosses were reported in the 1984 Sugarbeet Research report (see A65-66 and C16-20).

Leaf Spot Evaluations of Sugarbeet Lines Submitted by BSDF-Member Companies. (Project 25N)--E. G. Ruppel and G. A. Smith.

Separate randomized block designs with two replicates were used to evaluate a total of 171 lines submitted by six BSDF-member companies for resistance to Cercospora beticola. Internal controls were a highly susceptible synthetic, and a leaf spot resistant check FC(504 X 502/2) X SP6322-0. Two-row plots were 4 m long with 56 cm between rows. We inoculated twice (July 3 and 10), and evaluations were made August 22.

Conditions were ideal for leaf spot development, and the epiphytotic was quite severe. On our disease scale of 0 to 10, the resistant and susceptible checks had mean disease indexes of 4.1 and 7.0, respectively. Means of contributed lines ranged from 3.3 to 8.0. Results of the individual tests were tabulated, statistically analyzed, and sent to the approporiate contributor.

RHIZOCTONIA ROOT ROT RESEARCH AND DEVELOPMENT OF GENETIC RESISTANCE (BSDF Project 20)

1985 Rhizoctonia Field Research.--R. J. Hecker and E. G. Ruppel.

Our 1985 rhizoctonia field research was conducted on the Colorado State University South Farm. With the improvements that we have made, this site is proving to be ideal for our disease research. We are pleased and gratified to be a part of this three-way cooperative research involving the BSDF, Colorado State University, and ARS.

The 1985 rhizoctonia root rot research area had been fallow, barley, and barley in the preceding 3 years. The experimental plots were one row, 6.1 m (20 ft) long and 56 cm (22 in) apart, except for the tests of the BSDF-member contributed lines, where the plots were 4.3 m (14 ft) long. Experiments were planted May 15, except for the chemical control experiment (reported in a succeeding section) that was planted April 16, and were thinned around June 18. A heavy hatch of alfalfa web worm (not usually a sugarbeet pest) was controlled with one application of malathion on June 7. Dry, ground, barley-grain inoculum of Rhizoctonia solani (R-9) was broadcast July 16 at 6 g/20 ft of row in a band over each row with a tractor-mounted four-row granule applicator, except for the test on varying selection pressure reported in a succeeding section. Intermittent sprinkler irrigation was used to moisten and activate the inoculum.

The roots in all experiments were lifted between September 16 and 18 and individually rated for root rot. Disease index (DI) ratings were made on a scale of 0 to 7 (0 = no evidence of infection; 7 = plant dead and extensively decomposed). The percentage of healthy roots were those with index ratings of 0 and 1, those roots showing no active infection. The roots rated 0 through 3 also were analyzed as a class; these roots, in general, were sufficiently sound and large to be recovered in a commercial harvest. The epiphytotic of root rot in our 1985 rhizoctonia experiments was moderate and adequate for the evaluations of the various experiments; however, infection was not as intense as in 1984.

The succeeding sections under this BSDF Project 20 report describe individual experiments in our 1985 rhizoctonia root rot research project.

Evaluation of Contributed Lines for Resistance to Rhizoctonia Root Rot. (Project 20N)--E. G. Ruppel and R. J. Hecker

Randomized complete block designs with five replicates were used to evaluate 100 contributed lines from six BSDF-member companies. Internal control lines included highly resistant FC 705/1, resistant FC 703, and highly susceptible FC 901. Results of each contributor's test were statistically analyzed and sent to company breeders. The mean disease indexes for FC 705/1, FC 703, and FC 901 across all tests were 1.4, 2.1, and 5.4, respectively (scale of 0 to 7). Percent healthy means were 70.1, 53.6, and 6.6%, respectively.

Resistance Evaluations of Germplasms from the Rhizoctonia Root Rot Resistance Development Project.--R. J. Hecker and E. G. Ruppel.

The need for sugarbeet cultivars with high levels of rhizoctonia root rot resistance continues to be a high priority among some sugarbeet growers, particularly in certain growing areas. Current commercial hybrid cultivars offering some resistance have utilized resistant germplasm from our BSDF project in only one parent of the hybrid. Maximum resistance will be achieved when all parents in a hybrid are highly resistant. In Project 20, we have been developing resistance in pollinator and male sterile germplasms; however, in recent years, monogerm and O-type germplasms have received additional effort.

The breeding lines listed in Table 1 are those that have the most genetic resistance; most are multigerm. A number of these lines already have been released, i.e., FC 712, FC 711, FC 708, FC 708 CMS, FC 707, FC 705/1, and FC 703. Line FC 707 (4X) is in the process of being released. Other candidates for release are FC 707/2, FC 709, FC 710, FC 703/5, and our rhizoctonia resistant line developed from USSR multigerms (FC number not yet assigned).

In Table 2 are listed various lines being developed for rhizoctonia resistance, or included for review or comparison purposes. Entry 367 is a synthetic developed for rhizoctonia resistance from the ARS Fargo release, F1002. Entry 338 represents our effort to develop a rhizoctonia resistant line with high sucrose content. Entries 342, 346, and 348 are part of our attempt to introgress the apparent resistance in the fodder beet Peramono, a diploid monogerm fodder beet cultivar from West Germany. Peramono is one of only three Beta vulgaris germplasms we have found that is relatively rhizoctonia resistant among hundreds of germplasms that have been screened. Entries 337 and 336 are other entries in which we are attempting to introgress into sugarbeet the resistance discovered in an exotic culinary Beta vulgaris. Introgression of the genes from exotic sources into sugarbeet has potential to improve our existing level of rhizoctonia resistance only if the genes for resistance from these exotic sources are different than any of the resistance genes that we have accumulated in our existing germplasms. In the case of entry 336, a line made by selecting white root segregants from 337, there was no introgression of additive genes for resistance. In fact, this selection appears to have resulted in a loss of rhizoctonia resistance: DI = 3.8 vs. 2.2 in the F_2. At this point, it is impossible to deterimine if the resistance genes from the two sources are different, or if susceptibility might be linked with the genes for white root.

Entry 351 is a rhizoctonia resistant, type O, monogerm, leaf spot-resistant line. Entries 339, 340, and 341 are germplasms from Japan that are described as having some rhizoctonia resistance. It is not likely that we will continue these germplasms in our breeding effort. Entry 349 and 350 are monogerm type O and CMS lines resulting from selection for rhizoctionia resistance from segregating generations of FC 708 X a high sucrose, high combining-ability source. Entries 352 and 353 have been similarly derived from a different F_2 source. Entries 344 and 345 have been similarly derived from the F_2 of FC 708 X a curly top-resistant source. Entry 357 will be dropped. Entry 359 is an obsolete, commercial, open-pollinated cultivar. We have other lines in process of development that are not included in Table 2 because they were in the seed production phase in 1985.

Table 3 lists means for leaf spot ratings of certain rhizoctonia-resistant germplasms. Those lines that have relatively good leaf spot resistance, and which may have some potential use in development of resistant cultivars, are entries 1380, 1382, 1383, 1384, 1386, 1389, 1390, 1393, 1395. The leaf spot resistance that exists in any of these germplasms in Table 3 comes from their ancestors, since no selection was done for leaf spot resistance in these specific germplasms.

Selection for resistance to Rhizoctonia is continuing in many of the germplasms listed in the tables. We are, in most cases, inoculating each generation twice: in the vegetative stage in the field in July, and in the seed production phase in April when the mother roots are transplanted. Selection in the reproduction phase is primarily in the female, since much of the postinoculation infection (basis for roguing) does not become apparent until after the plant has contributed its male gametes to the pollen cloud. Our research into the development of methods to identify resistant genotypes in the male gametophyte are described under Project 76.

Table 1. Means of the most rhizoctonia-resistant breeding lines; disease index (DI), % healthy roots, and % of roots rated 0-3 (Exp. 4R, 1985).

Entry	Description	DI	% healthy roots		% rated 0 - 3	
			%	Arcsine	%	Arcsine
294	FC 707/2	1.4	63	54	98	84
300	FC 709	1.5	60	52	97	83
299	FC 710	1.6	54	48	95	80
301	FC 703/5	1.7	47	43	95	79
308	FC 712	1.7	57	50	91	73
309	FC 707(4X)	1.7	66	55	88	71
319	Sibline of FC 710	1.8	55	49	91	72
293	Rh resist. fr USSR MM's	1.8	59	51	89	74
320	Synthetic fr 24 S_1's; sel. for mm	1.8	54	47	94	79
295	FC 711	2.0	40	39	90	72
316	Sibline Rh resist. fr USSR MM's	2.0	36	37	90	72
311	FC 708; reindexed for TO	2.0	38	37	92	76
312	FC 708 CMS	2.0	39	38	91	76
313	FC 708	2.3	36	36	84	67
292	(FC 708 CMS X mm TO Rh lines)F_2	2.0	49	44	86	69
302	Syn. fr 24 S_1'S; TO	2.0	54	50	89	75
298	mm TO Rh line	2.1	33	34	93	76
310	FC 707	2.1	50	45	79	63
317	HH 32; commercial check	4.4	10	17	27	31
305	FC 705/1; high resist. check	1.6	62	53	91	73
306	FC 703; resist. check	2.4	39	38	74	60
304	FC 901; susc. check	5.4	3	7	17	23
LSD(.05)		0.45	*	9.6	*	8.0

*Not calculable; percent data were transformed to arcsines for statistically correct analyses, but means are reported in percent to be directly interpretable.

Table 2. Means of lines being selected for Rhizoctonia resistance; DI, % healthy roots, and % of roots rated 0-3 (Exp. 5R, 1985).

Entry	Description	DI	% healthy roots		% rated 0 - 3	
			%	Arcsine	%	Arcsine
367	Syn. fr F1002	2.1	40	39	86	71
338	Rh resist. high suc. popn. mm	2.1	36	36	87	69
342	FC 703/5 X Peramono, F_1	2.1	52	49	87	73

Table 2. Continued.

Entry	Description	DI	% healthy roots		% rated 0 - 3	
			%	Arcsine	%	Arcsine
346	(LSR mm CMS X FC 708) CMS X Peramono, F_2	2.4	35	35	82	66
348	Peramono	2.8	16	21	82	65
337	FC 707 X Rh resist. exotic; F_2	2.2	40	39	88	70
336	FC 707 X Rh resist. exotic, white root segregants	3.8	13	18	54	47
351	Rh resist. TO mm LSR popn.	2.6	34	34	78	62
339	Rh resist. mm (Japan)	3.4	16	23	60	51
340	Rh resist. mm TO (Japan TK-84)	6.1	0	0	6	13
341	Rh resist. mm CMS (Japan TK-84 CMS)	5.3	5	10	16	21
349	Rh resist. mm TO (high suc. source)	3.8	19	22	52	46
350	Rh resist. mm CMS(high suc. source)	3.8	13	17	47	43
352	Rh resist. mm TO (high CA source)	4.3	12	16	50	48
353	Rh resist. mm CMS (high CA source)	4.4	7	12	35	35
344	Rh resist. mm TO (CTR source)	4.8	10	13	35	33
345	Rh resist. mm CMS (CTR source)	4.3	11	17	41	40
357	Nebr. Rh resist. sel. (antique)	5.1	8	12	26	27
359	GW 602 (source of entry 357)	5.2	5	10	18	24
368	Mono Hy Rh 83; commercial check	4.0	8	14	34	35
369	HH 32; commercial check	3.8	13	18	44	41
354	FC 705/1; high resist. check	1.9	55	48	85	67
355	FC 703; resist. check	2.2	44	41	78	63
334	FC 901; susc. check	6.1	1	2	9	15
LSD(.05)		0.76	*	9.4	*	10.5

*Not calculable; percent data were transformed to arcsines for statistically correct analyses, but means are reported in percent to be directly interpretable.

Table 3. Cercospora leaf spot and rhizoctonia root rot ratings of Rhizoctonia-resistant germplasms (Exp. 3A, 1985, and 4R, 1985).

Entry	Description	Rhiz.[1] DI	LS[2] rating
1380	High CA pool X FC 708, F_3	4.3	4.5
1381	Type 0 syn. from 24 S_1's	1.8	4.5
1382	FC 708; reindexed for TO	2.0	4.8
1383	FC 708 CMS	2.0	4.8
1384	FC 707 (4X)	1.7	5.0
1385	FC 707; source of 4X	2.1	5.5

Table 3. Continued.

Entry	Description	Rhiz.[1] DI	LS[2] rating
1386	FC 703/5	1.7	5.0
1387	FC 705/1	1.6	5.5
1388	FC 707/2	1.4	6.0
1389	FC 709	1.5	4.2
1390	FC 710	1.6	5.0
1391	FC 711	2.0	5.8
1392	FC 712	1.7	6.0
1393	Syn. 1 from (mm, TO) X FX 701	---	4.2
1394	Rh resist. line from USSR mm's	1.8	6.2
1395	FC 703 X hi suc. lines	2.1	5.2
1396	Leaf spot resist. check	---	4.5
1397	Leaf spot susc. check	---	6.8
306	Rhizoc resist. check	2.4	---
304	Rhizoc susc. check	5.4	---
LSD (.05)		0.4	0.6

[1]Rhizoctonia disease index on 0 to 7 scale.
[2]Leaf spot rating on 0 to 10 scale.

Resistance Evaluations of Experimental Hybrids.--R. J. Hecker and E. G. Ruppel.

Eighteen experimental hybrids were compared for resistance in the inoculated nursery in 1986. These hybrids had resistant pollinators, and four (entries 272, 274, 275, and 277) had some resistance in the CMS parent due to the presence of FC 708. The additional genetically additive genes made these four hybrids more resistant, especially entries 274, 275, and 277. Hybrids with this level of resistance, over 90% of roots rated in the 0 to 3 classes, are likely to have sufficient resistance for even the most Rhizoctonia-prone growing areas.

Among the susceptible CMS parents, FC 607 CMS generally combined better for resistance than did (1861 CMS X 12166). The CMS parent (FC 505 CMS X SP 6323-0), although susceptible, combined well with its resistant pollinator (FC 703/5). This adds to previous evidence that both FC 505 and SP 6323-0 combine quite well for resistance with resistant pollinators.

Remnant seed is available for all the experimental hybrids in the table for productivity tests by interested BSDF cooperators.

Table 1. Rhizoctonia resistance evaluation of experimental hybrids (Exp. 3R, 1985).

Entry	Description	DI	% healthy roots		% rated 0 - 3	
			%	Arcsine	%	Arcsine
294	FC 707/2	1.4	63	54	98	84
260	(1861 CMS X 12166) X Rh MM fr USSR sources	3.3	18.8	22	54.5	48
261	FC 607 CMS X Rh MM fr USSR sources	2.4	39.8	38	72.5	59
262	(1861 CMS X 12166) X FC 707/2	2.6	41.5	40	65.8	55
263	FC 607 CMS X FC 707/2	2.7	31.0	33	65.5	55
264	(1861 CMS X 12166) X FC 710	2.8	35.0	36	62.3	52
265	FC 607 CMS X FC 710	2.4	42.5	39	68.8	57
266	(1861 CMS X 12166) X FC 709	2.8	31.0	33	65.5	55
267	FC 607 CMS X FC 709	1.9	54.0	49	84.3	70
268	(1861 CMS X 112166) X FC 703/5	2.4	33.3	35	74.3	60
269	FC 607 CMS X FC 703/5	2.2	43.5	41	77.3	62
270	SP632301 CMS X FC 703/5	2.2	46.0	43	84.5	70
271	(FC 505 CMS X SP 63230) X FC 703/5	1.8	57.5	50	86.8	69
272	((662119s1 CMS X 562) X FC 708) X FC 703(4x)	2.3	36.0	36	78.8	63
273	(FC 604 CMS X Polish mm) X FC 703(4x)	3.8	20.8	26	40.5	38
274	((662119s1 CMS X 562) X FC 708) X FC 712	1.8	58.8	51	91.0	78
275	(FC 708 CMS X Rh USSR mm) X FC 703(4x)	1.6	61.5	52	96.3	80
276	(FC 502/2 X 662119s1) X FC 702/6	2.3	41.3	40	72.3	59
277	(EL 44 CMS X FC 708) X FC 709	1.7	51.0	46	92.0	78
278	HH32	3.5	20.0	26	43.3	42
279	FC 705/1; high resist. check	1.3	77.8	62	98.5	86
280	FC 901; susc. check	5.3	4.5	8	16.8	24
281	FC 703; resist. check	1.9	52.8	48	87.5	72
	LSD(.05)	0.78	*	14.7	*	13.2

*Not calculable; percent data were transformed to arcsines for statistically correct analyses, but means are reported in percent to be directly interpretable.

Pre-Layby Application of Fungicides for the Control of Rhizoctonia Root Rot in Sugarbeet.--E. G. Ruppel and R. J. Hecker.

A randomized complete block design with five replicates was used to test three fungicides applied pre-layby for the control of rhizoctonia root rot under quasicommercial conditions in a field heavily infested with Rhizoctonia solani. Soil temperatures were monitored every 10 minutes at depths of 2.5 and 5 cm from planting (April 11) to layby (July 15).

Fungicides were pencycuron (Bay NTN 19701) 75% WP, HWG 1608, and KWG 0519 at rates of 28.4, 14.2, and 9.9 g/305m of row, each applied in 4 L of water with a CO_2-powered bicycle sprayer having #8006 banding nozzles turned parallel to the row and a pressure of 148 kPa (21 psi). Single applications to beet crowns were made "early" (May 16), "mid" (June 13), and "late" (July 12) to coincide with the cotyledon to two-leaf stage, the 8- to 10-leaf stage, and just before layby, respectively. Additionally, each chemical was applied sequentially early and late, with half the rates being applied each time. Untreated plots served as controls.

Two commercial sugarbeet cultivars included in the test were Mono-Hy A4, which is highly susceptible to R. solani, and Mono-Hy RH83, which has some resistance. Plots were 6 m long with 56 cm between rows and 20-25 cm between plants after thinning. Before planting and after harvest, population densities of R. solani were determined by means of a soil-pellet sampler amd a Rhizoctonia-selective medium.

Data included disease index (D.I.; scale of 0-7), percent healthy (classes 0 and 1 combined), root yield, percent sucrose, percent purity, and recoverable sucrose.

Results: The root rot epiphytotic was quite severe, with mean D.I.'s for the untreated susceptible and resistant entries of 6.0 and 4.8, respectively (Table 1). The resistant entry outperformed the susceptible entry for all parameters.

When the experiment was analyzed as a 2 x 13 factorial, differences among the 13 treatments were highly significant; however, entry X treatment interactions were significant. Thus, separate analyses were performed on each entry. In these AOV's, differences among treatments were highly significant, and mean separations are presented in Table 1. The overall trend in both entries was for better disease suppression with early, mid, and early/late treatment.

Since there were no significant interactions for any yield parameter, overall AOV's were used and LSD's are provided to compare each mean with its respective control (Table 2). Again, early, mid, and early/late applications generally were better than late applications. Overall, NTN 19701 and HWG 1608 compounds tended to be better than KWG 0519.

In 2 x 3 x 3 factorial analyses without the controls, fungicides were compared across entries and application times, and application times were compared across fungicides and entries (Tables 3 and 4, respectively). Mean separations showed that HWG 1608 was superior to the other chemicals in D.I. and percent healthy, and surpassed KWG 0519 in percent sucrose, percent purity, and recoverable sugar (Table 3). In the latter three parameters, HWG 1608 was not significantly different from NTN 19701, and there were no significant differences among fungicides in root yield. Although early, mid, and early/late applications reduced disease incidence and severity, differences among dates were not significantly different in any yield parameter (Table 4).

Table 1. Disease index, % healthy, and population densities of *Rhizoctonia* following single and sequential applications of fungicides for root rot suppression; means of five replications.[1]

Entry[2]	Fungicide	Treatment	DI	% Healthy[3]	*Rhizoctonia*[4]
201(R)	NTN 19701	Early	3.5 bcd	41.2 gh	2.7
		Mid	4.1 ab	33.0 hi	4.5
		Late	4.2 ab	31.6 hi	2.0
		Early/late	2.9 cde	54.6 fg	2.9
		(Mean)	(3.7)	(40.1)	(3.0)
	KWG 0519	Early	4.0 ab	32.0 hi	2.5
		Mid	3.5 bcd	36.4 h	1.3
		Late	4.8 a	19.2 ij	2.5
		Early/late	3.3 bcd	44.0 gh	1.8
		(Mean)	(3.9)	(32.9)	(2.0)
	HWG 1608	Early	2.5 de	57.0 fg	1.5
		Mid	2.9 cde	55.6 fg	1.5
		Late	3.9 abc	35.0 hi	1.8
		Early/late	2.2 e	62.6 f	1.5
		(Mean)	(2.9)	(52.5)	(1.6)
	Nontreated control		4.8 a	16.0j	3.8
202(S)	NTN 19701	Early	4.4 lmn	30.0 wx	1.8
		Mid	3.9 n	37.8 w	1.8
		Late	5.5 kl	14.4 yz	2.5
		Early/late	4.7 lmn	31.6 wx	4.0
		(Mean)	(4.6)	(28.4)	(2.5)
	KWG 0519	Early	5.3 klm	12.6 yz	2.9
		Mid	4.8 lmn	18.4 xy	3.3
		Late	5.4 kl	13.2 yz	1.5
		Early/late	4.9 lmn	22.2 xy	2.5
		(Mean)	(5.1)	(16.6)	(2.7)
	HWG 1608	Early	4.0 n	29.4 wx	2.5
		Mid	4.8 lmn	25.2 wxy	2.9
		Late	4.2 mn	33.0 wx	0.7
		Early/late	3.9 n	31.2 wx	1.1
		(Mean)	(4.2)	(29.7)	(1.8)
	Nontreated control		6.0 k	5.6 z	4.0

[1]Means within columns within entries followed by the same letter are not significantly different at P = 0.05 according to Duncan's multiple range test. Because of a significant entry (cultivar) X treatment interaction, separate analyses of variance were performed on the data from each entry. Thus, mean comparisons for individual treatments cannot be compared across entries.

[2]201 = resistant Mono-Hy RH83; 202 = susceptible Mono-Hy A4.

[3]Actual percentages are presented, but data was transformed to arcsines for statistical analyses.

[4]Population densities of *R. solani* are in propagules per gram soil. Prior to planting, the population density of the pathogen across the experimental area was 0.7 propagules per gram of soil.

Table 2. Root yield, % sucrose, % purity, and recoverable sucrose of two sugarbeet cultivars treated with fungicides for root rot suppression; means of five replications.[1]

Entry	Fungicide	Treatment	Roots	Sucrose	Purity	Recoverable sucrose
			t/ha	%	%	t/ha
201(R)	NTN 19701	Early	38.5	11.2	88.2	3.3
		Mid	32.8	11.0	88.2	2.8
		Late	36.6	11.8	87.4	3.2
		Early/late	38.5	11.1	87.7	3.2
		(Mean)	(36.6)	(11.3)	(87.9)	(3.1)
	KWG 0519	Early	36.7	10.7	87.3	2.9
		Mid	41.6	10.3	85.6	3.0
		Late	32.5	11.0	86.7	2.7
		Early/late	38.3	11.0	86.5	3.1
		(Mean)	(37.3)	(10.8)	(86.5)	(2.9)
	HWG 1608	Early	41.8	11.3	88.4	3.6
		Mid	43.6	12.6	89.3	4.2
		Late	35.1	11.7	89.1	3.2
		Early/late	42.1	12.6	89.8	4.2
		(Mean)	(40.7)	(11.4)	(87.9)	(3.8)
	Nontreated control		28.6	9.7	83.8	2.0
202(S)	NTN 19701	Early	31.4	11.3	89.1	2.7
		Mid	34.2	11.0	87.0	2.8
		Late	16.2	10.7	86.6	1.3
		Early/late	26.9	11.2	87.6	2.2
		(Mean)	(27.2)	(11.1)	(87.8)	(2.3)
	KWG 0519	Early	22.3	9.8	83.2	1.6
		Mid	30.2	9.6	85.5	2.0
		Late	24.7	10.3	86.6	1.9
		Early/late	23.9	9.7	86.7	1.8
		(Mean)	(25.5)	(9.9)	(85.5)	(1.8)
	HWG 1608	Early	32.5	10.6	87.6	2.6
		Mid	25.3	10.3	86.8	1.9
		Late	28.7	11.0	88.1	2.4
		Early/late	30.8	11.6	86.9	2.6
		(Mean)	(29.3)	(10.9)	(87.4)	(2.4)
	Nontreated control		16.0	8.9	82.9	0.9
		LSD(0.05)	10.2	1.3	2.7	1.1

[1]Means of five replicates. LSD's are provided for comparing each mean with its respective control mean. There were no significant interactions for any of the above parameters.

Table 3. Results of Duncan's multiple range tests performed on fungicide means across entries (cultivars) and application times (dates), excluding controls (factorial analysis).[1]

Fungicide	DI	Healthy[2]	Roots	Sucrose	Purity	Recoverable sucrose
		%	t/ha	%	%	t/ha
KWG 0591	4.5 a	23.2 c	31.4 a	10.3 b	86.0 b	2.4 b
NTN 19701	4.2 a	33.2 b	31.9 a	11.2 a	87.8 a	2.7 ab
HWG 1608	3.6 b	40.6 a	35.0 a	11.5 a	88.2 a	3.1 a

[1]Means of 40 measurements. Means within columns followed by the same letter are not significantly different at $P = 0.05$.

[2]See footnote 3, Table 1.

Table 4. Results of Duncan's multiple range tests performed on application-time (dates) means across entries (cultivars) and fungicides, excluding controls (factorial analyses).[1]

Date	DI	Healthy[2]	Roots	Sucrose	Purity	Recoverable sucrose
		%	t/ha	%	%	t/ha
Early	3.95 bc	32.4 b	33.9 a	10.8 a	87.3 a	2.8 a
Mid	4.00 b	33.0 b	34.6 a	10.8 a	87.2 a	2.8 a
Late	4.67 a	23.3 c	29.1 a	11.1 a	87.4 a	2.5 a
Early/late	3.62 c	40.1 a	33.4 a	11.2 a	87.5 a	2.9 a

[1]Means of 30 measurements. Means within columns followed by the same letter are not significantly different at $P = 0.05$.

[2]See footnote 3, Table 1.

Correlation analysis indicated a low ($r = 0.44$) but significant relationship between population density of *R. solani* and treatment D.I. There was no significant correlation between population density and fungicide D.I. ($r = 0.94$; Table 5); however, only two degrees of freedom were available for this test.

Discussion: *R. solani* is not active in soil at temperatures below 16 C, and its activity apparently is considerably slower below 25 C. Just before the early application of fungicides, soil temperatures reached and

sustained a range of 25-27 C for about 5 or 6 hours during midday, whereas soil temperatures reached 30 C or more before the mid and late applications. Apparently, the fungus is able to attack sugarbeets at a young stage, although severe symptoms usually appear much later. Thus, although not always statistically significant, early to mid applications seemed to provide more protection at a time when pathogen activity was beginning to increase. By the time the late applications were made, appreciable losses due to root rot had occurred.

All of the fungicides used in this study tended to reduce disease intensity and increase the yield of sugarbeet. However, in recoverable sugar, the ultimate criterion of success for a control measure, HWG 1608 provided the greatest return through the highest increase in yield. Early applications of this chemical caused some phytotoxicity (leaf burning and curling) of seedlings; however, the plants recovered and outyielded those in most other treatments.

Table 5. Disease indexes and population densities for fungicides across entries and application dates.

Fungicide	DI	Rhizoctonia[1]
Control	5.4	3.9
KWG 0519	4.5	2.4
NTN 19701	4.2	2.8
HWG 1608	3.6	1.7

[1]Propagules of R. solani per gram of soil.

Varying Selection Pressure Via Inoculum Rates and Inoculation Timing with Rhizoctonia.--E. G. Ruppel and R. J. Hecker.

To increase selection pressure on resistant germplasms and decrease pressure on susceptible germplasms, we tested two rates of dried, barley-grain inoculum (6 and 12 g/6 m row), two dates of inoculation (8 and 10 weeks postplanting), and two harvest dates (early and late) in a factorial experiment with highly resistant FC 707 (HR), intermediately resistant HH 32 (IR), and highly susceptible FC 901 (HS). The "early" harvest (August 28) was performed when FC 901 exhibited about 90% mortality; "late" harvest was made 21 days later (September 17). Results are presented in Table 1.

Results and Discussion: Analyses of variance of disease index (D.I.) and percent healthy data indicated highly significant differences among cultivars and between inoculum rates, inoculation dates, and harvest dates.

Table 1. Effect of two dates of inoculation, two rates of inoculum, and two harvest dates on rhizoctonia root rot severity in three sugarbeet cultivars; means of five replicates.

Entry	Inoculum rate (g/6 m)	Inoculation date	Harvest date	D.I.	% healthy
HR	6	Early	8/28	0.8	89
			9/17	1.6	71
		Late	8/28	0.6	97
			9/17	0.8	91
	12	Early	8/28	1.9	64
			9/17	2.5	51
		Late	8/28	0.9	82
			9/17	1.1	84
IR	6	Early	8/28	3.1	39
			9/17	4.4	21
		Late	8/28	1.2	68
			9/17	1.8	58
	12	Early	8/28	4.4	18
			9/17	5.8	4
		Late	8/28	1.6	57
			9/17	2.1	47
HS	6	Early	8/28	4.9	17
			9/17	5.8	7
		Late	8/28	2.0	48
			9/17	3.0	28
	12	Early	8/28	6.5	2
			9/17	6.0	6
		Late	8/28	3.0	32
			9/17	3.1	27

In the analyses, several significant interactions preclude definite statements about main treatment effects, but certain trends were evident as can be seen in a summary of disease indexes (Table 2) across the cultivars.

Generally, the greatest effect on disease severity was realized with inoculation date; the mean D.I.'s for early and late inoculation were 4.0 and 1.8, respectively. Doubling the inoculum rate or delaying harvest by 3 weeks only resulted in D.I. increases of 0.7 and 0.6, respectively.

Although preliminary, recommendations for establishing root rot epiphytotics to evaluate sugarbeet germplasms would differ depending on the

Table 2. Summary of disease indexes for main-effect interactions across three cultivars.

Inoculation[1]	Inoculum rate[2]	Harvest date[3]	Disease index
Early	Low	Early	2.9
		Late	3.9
	High	Early	4.3
		Late	4.8
		(Mean)	(4.0)
Late	Low	Early	1.3
		Late	1.9
	High	Early	1.8
		Late	2.1
		(Mean)	(1.8)

[1]Early and late inoculation = 8 and 10 weeks postplanting, respectively.

[2]Low and high = 6 and 12 g/6m of row, respectively.

[3]Early and late harvest = August 28 and September 17, respectively.

inherent resistance of the materials to be tested. For initial screening of materials with low or no known resistance, a later inoculation with the low inoculum rate and early harvest would provide better identification of low levels of quantitative resistance (Table 1). If a slightly higher disease intensity is desired, inoculum rate can be increased and harvest delayed a few weeks. Conversely, maximum selection pressure on moderately to highly resistant materials could be achieved with early inoculation, a high rate of inoculum, and a later date of harvest (Table 2).

IN VITRO RESEARCH ON TECHNIQUES FOR SELECTING RESISTANCE TO CERCOSPORA

BSDF Projects 75 and 91 share one objective in common: the development of techniques for selection of sugarbeets resistant to Cercospora beticola. The two projects are complementary, but the complexity of the objective dictates that we explore various biological and chemical parameters associated with resistance. Accordingly, these two project reports are presented together as an overview of the progress to date.

IN VITRO SELECTION AND REGENERATION RESEARCH
(BSDF Project 75)

G. A. Smith

Gametophytic Generation (Pollen) Screening. To facilitate the development of a model system, we have continued our work using the herbicide ethofumesate as a challenging agent. In some recent studies, we germinated pollen from six clones in a medium containing 0 or 15 mg/L ethofumesate. The two clones with the greatest pollen germination (most tolerant response) in the ethofumesate were intercrossed. The remaining four clones, all of which provided less tolerant pollen, also were intercrossed. Seed from the 'tolerant pollen' and 'non-tolerant pollen' intercrosses were tested in soil containing 0, 6, and 12 mg/kg ethofumesate. Six and 12 mg/kg equals two and four times the recommended field rate for ethofumesate, respectively. Progeny from clones rated as tolerant in the pollen test had a more normal leaf morphology and greater top and root dry weights as compared with progeny from the non-tolerant source (Table 1). These preliminary tests suggested that a plant's tolerance to ethofumesate may be measured by the response of its pollen. Further tests are being conducted to determine the reliability of this method.

The techniques developed with the model ethofumesate system are being applied to other toxins. Cercosporin (CN) and CBT produced by Cercospora beticola are being tested with procedures similar to the ethofumesate model. The first experiments with CN and CBT were designed to determine the appropriate concentrations of toxin to add to pollen-germination medium. Both toxins are lipoidal and, hence, are only slightly soluble in water. However, enough CN does dissolve in water to yield sufficient concentration for pollen-germination tests.

We found that CN at very low concentrations (e.g., 4.0 mg/L) completely inhibited pollen germination. Saturated, aqueous solutions of CBT, however, decreased pollen germination by only about 20%. CBT dissolved first in a small amount of ethanol and then brought to volume with pollen-germination medium (60 mg/L of CBT) decreased in vitro pollen germination 80%.

Genetic Variance of Cercosporin and CBT Resistance. In current studies, we are attempting to determine the genetic variance for gametophytic CN and CBT resistance. If sufficient genetic variance for either of these traits is found in the gametophyte, it may be possible to select for CN or CBT resistance in the gametophytic generation and expect a correlated response for leaf spot resistance in the sporophytic generation. Preliminary results have been mixed. In two separate experiments, pollen from leaf spot susceptible (LSS) and resistant lines (LSR) was challenged by various concentrations of either CN or CBT. In the CN experiment, pollen from the LSS line was most resistant (Table 2), whereas in the CBT experiment, pollen from the LSR line was most resistant (Table 3). Further experiments are planned to accurately compare LSR and LSS lines.

Vitrification in Shoot Cultures. Vitrification or "waterlogging" of leaf tissue in culture often results in death of shoot cultures and the

loss of valuable genetic material. Vitrification appears to be abiotic. Parameters, such as type and concentration of agar and plant growth regulators, lighting conditions, and genotype, may be involved in the onset of vitrification. We are studying the effects of these parameters on and vitrification frequencies.

Callus Production, Antibiotic Sensitivity. In other research, we are investigating conditions that trigger callus production, callus differentiation, and subsequent shoot production. We have found that white callus proliferates rapidly on MS medium plus 2% sucrose, and can be stored in mineral oil (which inhibits growth) for up to 4 months. Hard, knobby green callus has been initiated rapidly (2-3 weeks @ 22 C) from shoot cultures grown on medium containing benzyladenine (BA). This callus can be induced to produce shoots fairly consistently when maintained on BA. In antibiotic sensitivity tests, we have found that penicillin-G at about 50 mg/L of medium generally inhibits the growth and subsequent culture contamination by apparently endogeneous bacteria.

Table 1. Comparison of 'tolerant' and 'non-tolerant' lines as determined by pollen germination in medium containing high concentrations of ethofumesate.

		Entries		
Character	Conc.	Tol-1[1]	Non tol-1	UNS
Seedling emergence[2]	L[3]	96.6	94.2	100.0
	H	98.3	73.1	98.0
Leaf development	L	86.2	38.8	35.1
	H	53.4	4.1	24.3
Root dry weight @ 28 days	L	79.5	57.2	57.3
	H	93.4	56.7	83.4
Top dry weight @ 28 days	L	76.6	67.6	75.2
	H	67.7	47.2	72.5

[1]Tol-1 = 'tolerant' seed based on pollen test; Non tol-1 = 'non-tolerant' seed based on pollen test; UNS = unscreened seed from original population.

[2]% of check = % of untreated check within entry.

[3]L = 6 mg ethofumesate per kg of soil; H = 12 mg ethofumesate per kg of soil.

Table 2. The response of a leaf spot resistant (LSR) and leaf spot susceptible (LSS) cultivar to cercosporin.[1]

Cercosporin concentration	Pollen germination (%)		Pollen Germination as % of check	
	LSR	LSS	LSR	LSS
(mg/L)				
0	27.6	27.9	100	100
0.04	15.3	22.5	55.1	80.3
0.40	10.5	15.4	37.5	54.7

[1]LSR line = FC 606 T.O., LSS line = RG Pioneer.

Table 3. The response of a leaf spot resistant (LSR) and leaf spot susceptible (LSS) cultivar to CBT.[1]

Cercosporin concentration	Pollen germination (%)		Pollen Germination as % of check	
	LSR	LSS	LSR	LSS
(mg/L)				
0	28.6	27.4	100	100
30	22.5	13.8	81.0	44.5
60	9.8	4.7	23.2	13.6

[1]LSR line = FC 609 T.O.; LSS Line = RG Pioneer.

IDENTIFYING RESISTANCE TO CERCOSPORA LEAF SPOT BY SELECTING FOR RESISTANCE TO THE TOXINS "CERCOSPORIN" OR "CBT" (BSDF Project 91)

Bioassays of Cercosporin vs. Leaf Disks.--S. S. Martin

We reported previously (1984 Sugarbeet Research Report) that sugarbeet cultivars differing in field resistance to Cercospora leaf spot appeared to react differentially to cercosporin (CN) in vitro. During the past year this work was extended to an examination of the in vitro response of sugarbeet leaf disks to CN. Two responses to CN were evaluated: (1) loss of chlorophyll, and (2) leakage of sodium (Na^+) and potassium (K^+) into the bathing medium. These responses were chosen because of the known ability of CN to induce chlorosis and necrosis (i.e., loss of chlorophyll and death) and to alter the permeability of cell membranes (i.e., cause cells to become "leaky").

Preliminary experiments consistently showed a signficant increase in ion leakage from leaf disks exposed to CN, but the disks' chlorophyll content was not significantly decreased under the test conditions. Because this work is still in an exploratory phase to define the effect of several factors on ion leakage, only the Na^+ and K^+ efflux data from a single example will be presented here.

Sugarbeets of four cultivars differing greatly in degree of field resistance to C. beticola were germinated in steamed soil in the greenhouse and grown under natural and supplemental artificial light until they were 6 weeks old. Seedlings were thinned to three per pot when at the first or second true leaf stage. Disks of 5 mm diameter were punched from healthy, fully-expanded leaves by means of a revolving punch (designed for punching holes in leather); the punch anvil was cushioned by slipping a piece of thick-walled rubber vacuum tubing over it. Each treatment unit consisted of 3.0 ml of the appropriate solution [distilled water (DW = control) or saturated aqueous CN, respectively], in a 35 X 10 mm polystyrene petri dish. Preliminary experimentation showed that it was beneficial to pair control and CN treatment disks. Ten disks for each CN treatment unit were punched from one half (one side of the mid-vein) of three or four leaves, areas free of major veins. The paired disks for DW treatment were punched as nearly opposite the previous disk-punches as possible, again only from healthy areas free of major veins.

Because CN is a photosensitizing toxin, a procedure was adopted of vacuum infiltration of the leaf disks with the appropriate treatment solution, followed by initial incubation at room temperature in the dark. Disks were vacuum infiltrated with the solution by four cycles of evacuation to ca. 250 mm and slow return to atmospheric pressure, then transfered immediately to a random arrangement in a dark cabinet. At the end of the dark incubation period, the initial incubation medium (DW or CN) was removed and analyzed in duplicate for Na^+ and K^+ by flame photometry with lithium internal standard. The disks of each dish were washed 3X with DW, then 3.0 ml DW was added. Dishes were arranged randomly under fluorescent light on the laboratory bench and incubated an additional 24 hours in light (ca. 30 uE m^{-2} s^{-1}), after which the medium again was analyzed for Na^+ and K^+. This light regime (dark, then light) was chosen with the reasoning that an initial dark period would permit gradual infiltration of the toxin, then the toxin solution could be removed and DW substituted. Subsequent exposure to light should permit the infiltrated toxin to cause ion leakage into the DW medium. Some exposure of the disks to light was unavoidable, of course, during the initial preparation and vacuum infiltration steps.

CN-treatment significantly increased both Na^+ and K^+ efflux into the medium at each of the two analysis times (into the original treatment medium after 4 hours dark incubation, and into DW 24 hours after removal of the initial treatment medium). Each cultivar's response is shown in Table 1 as net increase in Na^+ and K^+ due to CN-treatment. Cultivars differed significantly in leakage of sodium both after four hours dark incubation [Na(Dark) in Table 1] and after 24 hours light [Na(Light)]. In both cases, sodium efflux was inversely related to degree of field resistance to C. beticola. Duncan's multiple range test (at probability level 0.05) for Na^+ in the two incubation media showed significant difference between the most

susceptible cultivar (Pioneer) and the most resistant ones (FC 607 and FC 504...), with SP-5822, which has a moderate level of resistance, being intermediate in efflux. In this test there was about a 1.5-fold maximum difference between cultivars for Na^+ efflux during 4 hours dark, and about a 3-fold maximum difference for Na^+ efflux after 24 hours in the light; greater differences have occurred in other experiments in which conditions differed from those described here. Although net potassium leakage exceeded that of sodium, no significant difference among cultivars occurred.

Experiments to date demonstrate that significantly more sodium and potassium leak into the incubation medium from leaf disks vacuum infiltrated with CN solution than from controls infiltrated with water. The data suggest an inverse correlation between membrane permeability as assessed by ion efflux, especially sodium, and known field resistance to Cercospora. We are continuing to explore the effect of factors such as light intensity, initial incubation conditions, plant age, age and position of leaves sampled, and time of treatment on ion efflux. This should permit us to define more nearly optimal conditions for the evaluation experiments, which then will be expanded to include additional sugarbeet cultivars of known relative resistance to leaf spot disease.

Table 1. Mean net efflux of sodium (Na^+) and potassium (K^+) into incubation medium for sugarbeet leaf disks from four cultivars.[†]

Cultivar		--------Ion leakage, ug/10 leaf disks-------- Na(Dark)	K(Dark)	Na(Light)	K(Light)
Pioneer	Most Susceptible	24.0 a	46.5	17.9 a	33.1
SP-5822		22.9 ab	58.5	12.8 ab	36.0
(FC 504 X FC 502/2) X SP 6322-0		16.3 bc	56.2	5.4 b	28.4
FC 607	Most Resistant	14.6 c	49.6	5.8 b	28.9

[†]For each cultivar, three replications each consisting of ten disks per treatment were incubated at 23 C for 4 hours in dark on saturated aqueous cercosporin solution, then transferred to glass distilled water for 24 hours incubation in light. Data are mean net ion leakage (µg/10 disks) due to cercosporin treatment (after subtraction of ion leakage in paired controls treated with DW instead of cercosporin solution, and correction if required for any Na^+ and K^+ in the cercosporin solution). Within columns, means not followed by the same letter differ significantly by Duncan's multiple range test (0.05 probability level).

BIOLOGY AND PATHOGENICITY OF DIVERSE ISOLATES OF *FUSARIUM* FROM SUGARBEET (BSDF Project 90)

E. G. Ruppel

Isolations from diseased sugarbeet roots from California, Canada, Colorado, Montana, Oregon, Texas, and Wyoming yielded *Fusarium acuminatum*, *F. avenaceum*, *F. equiseti*, *F. lateritium*, *F. proliferatum*, *F. oxysporum*, *F. sambucinum*, and *F. solani* (*F. oxysporum* is the reported cause of fusarium yellows).

In a preliminary pathogenicity test of three isolates each of *F. oxysporum* and *F. solani*, all isolates induced some degree of root discoloration and/or degradation. In a second pathogenicity test with six isolates of *F. oxysporum*, seven of *F. solani*, and two of *F. acuminatum*, only one plant of three replicates infested with *F. acuminatum* wilted and showed symptoms of root necrosis; all other plants were symptomless regardless of isolate. However, when a 4-cm section of hypocotyl from each plant was surface-disinfested and plated on *Fusarium*-selective medium, all yielded cultures identical to the *Fusarium* isolate used for inoculation. Further, all hypocotyl sections rotted except those from uninoculated control plants.

Although preliminary, it appears that certain isolates of *F. acuminatum* and *F. solani* besides *F. oxysporum* are pathogenic in sugarbeet. Our results from the second pathogenicity test also indicate that many isolates of the *Fusarium* species can colonize sugarbeet seedling roots without inducing disease symptoms. As in other host-*Fusarium* systems, some environmental stress on the plants may be needed for symptoms to become manifest.

The colonization of sugarbeet roots with *F. acuminatum*, *F. avenaceum*, *F. equiseti*, and *F. sambuncinum* appears to have some specific attributes. According to Nelson et al. (*Fusarium* Species: An Illustrated Manual for Identification, Pennsylvania State Univ. Press, 1983), these species usually do not produce microconidia in culture. But every sugarbeet isolate of these species from diverse locations produces moderate to abundant microconidia.

Cultural characteristics of 16 *Fusarium* isolates on freshly-made potato-dextrose agar (PDA) differentiated five distinct biotypes of *F. oxysporum* and five of *F. solani*. Two isolates of *F. acuminatum*, both from Texas, were identical in culture. PDA prepared from fresh potatoes was an excellent medium for pigment and conidia formation in culture, but conidia were not as uniform for identification purposes as on carnation-leaf agar or freshly-made potato-carrot agar.

Further work is needed: to test the pathogenicity of individual isolates, to determine the conditions of stress that precipitate disease symptoms following colonization by pathogenic isolates, to evaluate interactions between *Fusarium* species in the disease syndrome, and to determine whether isolate X cultivar interactions should be of concern in breeding programs.

GAMETOPHYTE-SPOROPHYTE COMPLEMENTATION AND POLLEN TECHNOLOGY TO ASSESS AND SELECT FOR ECONOMIC CHARACTERS (BSDF Project 76)

For plant improvement, pollen has been a relatively neglected part of the life cycle of plants. However, since pollen is haploid and each cell is independent, it provides a microbial-like system for evaluation, assay, and even selection. The research in this project is designed to make discoveries of concepts and methods by which sugarbeet breeders may be able to make more accurate assessments of genetic worth, more accurate genetic selection, and more rapid genetic improvement by using pollen rather than whole plants. The subsequent sections of this project report describe results of experiments on concepts and techniques.

Relation of Hybrid Vigor and Gametophyte-Sporophyte Complementation.--
R. J. Hecker.

We have completed 2 years of root-yield testing of 15 half-sib hybrid pairs that, from preliminary tests, indicated the two hybrids of a pair were different for root yield (heterosis). Table 1 shows that only eight were significantly different in the 2-year test. However, controlled pollinations had been made of all 15, e.g., CMS 1 rr (green hypocotyl) was pollinated with pollen from male fertiles A rr and B R_, the pollen having been mixed in appropriate proportions before application to CMS 1. Likewise CMS 2 was treated with a pollen mix from males C rr and D R_ etc., through all 15 CMS's. All 15 CMS's were rr. The progeny from each CMS, 221 to 4,305 plants per CMS, were classified for hypocotyl color. This obtained frequency of pink hypocotyl plants (R_) is in Table 1. The expected frequency (Table 1) was calculated from the known frequency of the r gene in the pollinators, assuming equal frequency of fertilization by the two pollens. The gametophyte-sporophyte (G-S) complementation index is the deviation of obtained from expected frequencies. The sign of the index indicates the relation of the deviation with heterosis measured in the field tests.

The hypothesis being tested is that heterosis is related to pollen tube-stigma complementation. This complementation is expressed as tube growth rate of a specific pollen in a specific stigma. It further assumes that the fastest growing tubes, on average, effect fertilization first. Hence, the hypothesis is tested by comparing fertilization frequencies as outlined above.

Ten of the 15 complementation indices in Table 1 were positive. However, when one considers only significantly different hybrid pairs, 5 of 8 were positive. These signs and the magnitude of the indices give an indication of a positive relationship between heterosis and G-S complementation, but at this point, the hypothesis can neither be accepted nor rejected.

The determination of equal quantities of pollen from each pollinator remains unresolved. The 29,424 seedlings classified for hypocotyl color in Table 1 resulted from three methods of pollen mixing. First, pollen was

Table 1. Mean root yield for 2 years (kg/6.6m plot) of pairs of half-sib hybrids, expected and obtained frequencies of green and pink hypocotyl progenies from controlled pollinations within hybrid pairs, and gametophyte-sporophyte complementation indices.

Hybrid pair	Root yield	Progeny frequency		Complement. index
		Expected R_	Obtained R_	
1	13.26	.40	.46	+.06
1	15.88*			
2	15.26	.36	.39	-.03
2	18.30*			
3	18.27	.5	.37	+.13
3	20.00*			
4	16.62	.5	.41	+.09
4	20.14*			
5	16.42	.51	.38	-.13
5	18.01*			
6	17.80	.5	.94	+.44
6	20.41*			
7	13.66	.5	.72	+.22
7	14.98			
8	14.57	.5	.62	+.12
8	13.31			
9	14.48	.5	.53	+.03
9	15.60			
10	13.83	.5	.62	+.12
10	15.16			
11	16.75	.5	.45	-.05
11	19.10*			
12	20.35	.32	.45	-.13
12	21.01			
13	18.51	.43	.54	+.11
13	19.82			
14	17.89	.42	.24	+.18
14	16.04*			
15	17.42	.45	.46	-.01
15	16.55			

*Pair of means are significantly different (.05).

collected and the two male sources mixed in equal proportion by weight. Second, a viability test was made with fluorescein diacetate and the two pollens mixed in proportion to viability. Third, the vital stain isatin was used to determine the mix proportions. I am not satisfied that either of these vital stains are providing a measure of actual capacity of the pollen to fertilize. We are continung to look for a good vital stain that will assure the accuracy of our pollen-mix ratio.

The potential for early extensive combining ability testing that this complementation concept offers is so great that I feel it worthy to continue the project to examine several in vitro techniques that may measure the complementation that results in heterosis. A more refined version of the above experiments will also be executed.

Pollen Germination and Vital Stains.--R. J. Hecker

There is potential for making genetic improvement in sugarbeet through biotechnological applications in the gametophytic (pollen) generation. The use of pollen in a microbial-like manner requires that there be parameters, e.g., survival, germination %, tube length, tube growth rate, etc., that are measurable and which respond to treatment, challenge, etc. This requires development of in vitro pollen culture techniques. Our 1984 Project 76 report detailed our preliminary research and results on sugarbeet pollen germination. This report will up-date and modify those results.

Our current best technique for in vitro pollen germination is as follows:

1. Liquid medium.
2. Medium stock solution: 1 liter distilled H_2O; 0.1 g H_3BO_3; 0.1 g $Ca(NO_3)_2 \cdot 4 H_2O$; (Stock solution can be kept refrigerated).
3. Germination medium: 32 g sucrose brought up to 100 ml with stock solution (do not store).
4. pH 5.5; adjust with HCl or NaOH after mixing sucrose and stock.
5. Pollen hydration: 15 min in a closed 100% humidity environment.
6. Pollen density: 1.3 mg pollen/4.5 ml medium, in a 6 cm petri dish.
7. Germination: 23 C for 24 hours; light is not a factor.
8. Arrest pollen and microbial growth by adding one drop of formalin per dish.
9. Store refrigerated until examined.

Using current techniques, our pollen germinations range from 15 to 60%, averaging about 30 to 35%. Although we know that beet pollen has a relatively short post-dehiscence life, I feel that our germination medium and technique still may be lacking. Hence, we are continuing to investigate methods to enhance germination. A recent positive effect resulted from augmentation of the medium with stigmatic extracts. This positive effect and an interaction of extract and pollen has indicated new

possibilities for detecting complementation and incompatibility. These ideas will be investigated next year.

When percent pollen viability is the parameter of interest, it would be more efficient to use a vital stain than to germinate the pollen in vitro. However, our comparisons of vital stains with in vitro germination have failed to show a close relationship. We have tested the vital staining capabilities of tetrazolium bromide, fluorescein diacetate, and isatin. The results among stains are more closely related than are the stains with germination. Each of these stain materials react with a unique vital life process to make the pollen purple, fluorescent, or brown, respectively. Therefore, it must be assumed that pollen loses its germination capability before it loses its capability to react with the stain. We are testing other potential vital stains because a rapid test for viability is essential for the application of some pollen technologies.

Selecting and Assaying in Pollen.--R. J. Hecker.

In a recent publication, the authors, from their Tradescantia research, report,"...about 85% of the genes expressed in pollen are also expressed in sporophytic tissue and no more than 15% of the genes expressed in the pollen are unique to it." (Willing, R. P. et al. 1984. Plant Cell Incompatibility Newsletter 16:11-12). If this is the general case in plants, then all that prevents plant breeders from doing most of their breeding work in the lab using pollen is the lack of technique to measure the specific pollen gene effects. This finding of Willing, et al., may portend a complete revolution of plant breeding methods.

Pollen grains are like single cells that can be exposed by the millions to a challenging agent, then pollen function, lethality, germination, or pollen tube growth might be used to evaluate the plants that produced the pollen. Surviving, or the most functional pollen, also might be used for pollination.

We have in process a pollen selection experiment wherein pollination and fertilization was done at 8 C. Hence, the pollen was challenged by low temperature. The hypothesis is that those pollen grains having genotypes that make them more functional at low temperature will effect fertilization most frequently, and that this low temperature tolerance in the pollen will be expressed in the sporophyte by more rapid seed germination and seedling development at low temperature. After two cycles of fertilization at 8 C, there was a nonsignificant trend toward more rapid cold-soil germination and emergence in selections than in controls. However, the germination of pollen in vitro at 6 and 12 C showed slower germination but longer tubes of pollen from selections than controls. The experiment will be continued a few more cycles.

In another set of experiments, we attempted to test Rhizoctonia resistance of plants by exposing pollen from the plants to culture-medium extracts of R. solani. We found no consistent effect of the extracts on the in vitro germination of pollen from Rhizoctonia resistant and susceptible plants. We will be doing more experiments with different rhizoctonia cultural extracts.

The potential for research breakthroughs in this area of pollen selection and assay warrants continuing this research next year.

Storage of Sugarbeet Pollen in Liquid Nitrogen.--R. J. Hecker

Long-term preservation of sugarbeet pollen is needed so that scientists and breeders can preserve superior or unique pollen. They then could use it over an extended period to repeatedly make superior hybrids or special genetic combinations.

The technology for pollen preservation has been developed for only a few crops, and never for sugarbeet. Our research has developed techniques for sugarbeet pollen preservation in liquid nitrogen (LN) whereby pollen was maintained as viable as fresh pollen. Although this test of cryogenic storage was only for 1 year, there is every reason to expect that pollen now in LN still will be alive when it is tested 5, 10, and 20 years from now.

From our research we recommend the following techniques: Abundant pollen was collected by shaking flowering plants over a large glass plate. A flat blade was used to scrape the pollen from the plate onto a smooth paper which was then bowed, inclined, and tapped to remove anthers and other debris. Pollen can be collected from plants in any environment, e.g., field, field-tent isolators, greenhouse, etc. Pollen moisture is critical. LN is lethal to pollen over 18% moisture. Our field collections ranged from 26 to 32% moisture, and greenhouse pollen was 16 to 21%. Hence, any pollen destined for storage should be desiccated. In a small closed container, we placed pollen over a bed of anhydrous calcium chloride and refrigerated 24 hours. This reduced pollen moisture to 6 to 12%. Pollen was transferred to small, plastic, cryotubes with screw cap and silicon gasket, which were stored in the vapor phase over LN (-150 to -196 C) or in LN (-196 C). Upon removal from storage, pollen was allowed to warm in cryotubes at 23 C for 30 min. Pollen should then be humidified 15 min. We used a small, closed, seed germination box lined with wet blotter material. This humidification did not improve the pollen's ability to effect fertilization, but was essential for in vitro pollen germination testing. Thawed, humidified pollen can be dispensed onto flowering plants with an air-bulb atomizing apparatus. The effective minimum quantity that can be dispensed is about 4 mg. Beet pollen weighs about 310 mg/cc.

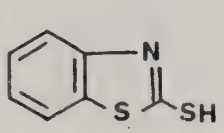
We have removed cryotubes from LN, taken some pollen, then replaced the tubes into LN, without apparent ill effect. However, if intermittent needs for pollen are anticipated, it may be advisable to divide the pollen into several cryotubes for LN storage.

This new technology should facilitate previously impossible hybridizations, and may be a reliable, inexpensive method to preserve and conserve genetic resources for generations to come.

SUGARBEET EXTRACT CLARIFICATION
(former BSDF Project 81)

2-Mercaptobenzothiazole: An Extremely Effective Inhibitor of Sugarbeet Polyphenol Oxidase. --S. S. Martin.

In the 1984 Sugarbeet Research Report (pp. C36-C40) I described the importance of polyphenol oxidase (PPO) in sugarbeet extract oxidative darkening, and the effectiveness of 2-mercaptoacetic acid (2-MAA) as a PPO inhibitor. This report describes another inhibitor, 2-mercaptobenzothiazole (2-MBT), which is even more effective.



2(3H)-BENZOTHIAZOLETHIOL
2-MERCAPTOBENZOTHIAZOLE

2-MBT

In the reaction previously outlined (ibid) for oxidation of tyrosine by isolated sugarbeet PPO, 2-MAA was fully inhibitory at a final reaction mixture concentration of 1.8×10^{-3} M. In the same test system, 2-MBT at 3.0×10^{-5} M was completely inhibitory, and 3.0×10^{-6} M 2-MBT inhibited the reaction for about 20 minutes (Figure 1). Inhibition seemed to be virtually instantaneous, as incubation of PPO with 2-MBT for up to 15 minutes prior to adding the reaction substrate had no effect on the inhibition.

Polyphenol oxidases are copper-containing metalloenzymes, and it seemed likely that the inhibitory properties of the thiol compounds 2-MAA and 2-MBT were due to their interaction with enzymic copper. The presence of 2-MBT at 3.5×10^{-5} M fully inhibited sugarbeet PPO's ability to oxidize tyrosine in the test system, but addition of 0.1 mM Cu^{++} (as $CuSO_4$) to the otherwise identical reaction mixture (at t_0) fully overcame the inhibition (Figure 2). If Cu^{++} were added to the 2-MBT-inhibited reaction mixture part-way through the inhibition period (for example, at 12 minutes in Figure 2), the oxidation of tyrosine, as assayed by increased absorbance due to dopachrome formation, gradually resumed although at a lesser rate than in the uninhibited reaction. Essentially, the same results were obtained when 2-MAA was the inhibitor. Thus, it appears that the mechanism of inhibition of sugarbeet PPO by these inhibitors is the complexing of copper.

Because they are effective inhibitors at such low concentrations, 2-MBT and 2-MAA should be useful in the preparation of extracts for many purposes (perhaps even including enzyme analyses where the object is not a metalloenzyme). From a practical consideration, 2-MBT is not very water-soluble; for these experiments, it was prepared by stirring a saturated aqueous solution overnight, then filtering. It is highly absorptive in the ultraviolet, and the absorbance at the λ_{max} even in this dilute aqueous solution is unreadable. Therefore, its concentration was determined by calculation from the absorbance of an accurate volumetric dilution and log ϵ

= 4.39 at 320 nm. Titration with standardized silver nitrate also could be used. For some purposes 2-MBT might be used by dissolving it in MeOH or EtOH, then adding appropriate volumes to the solution of interest.

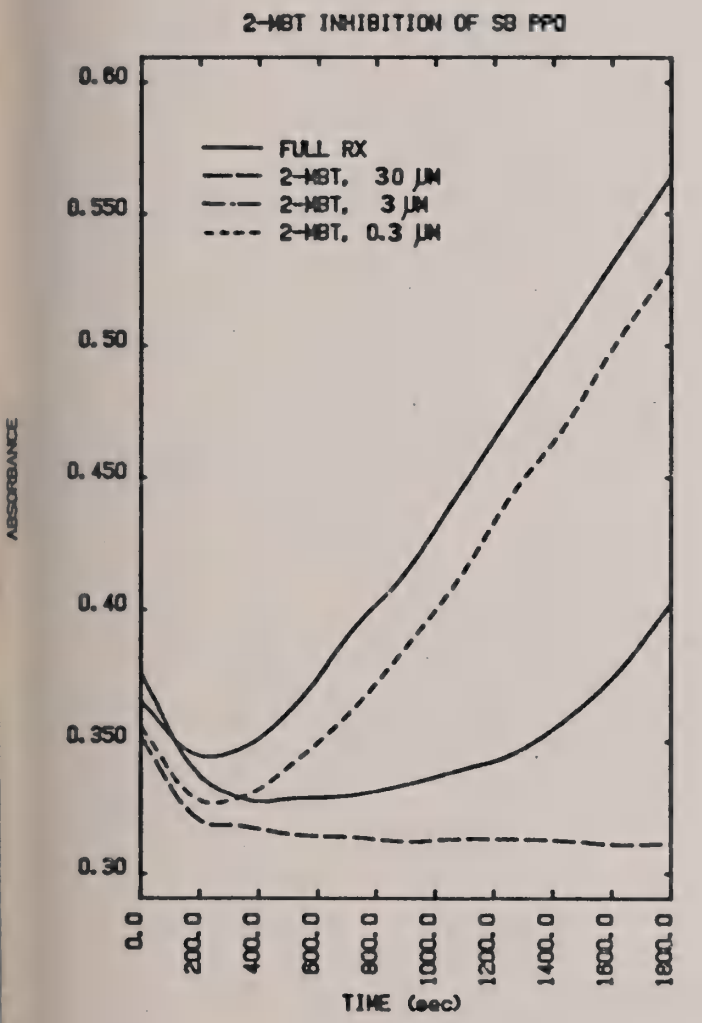


Figure 1. Inhibition of sugarbeet polyphenol oxidase by 2-mercaptobenzothiazole.

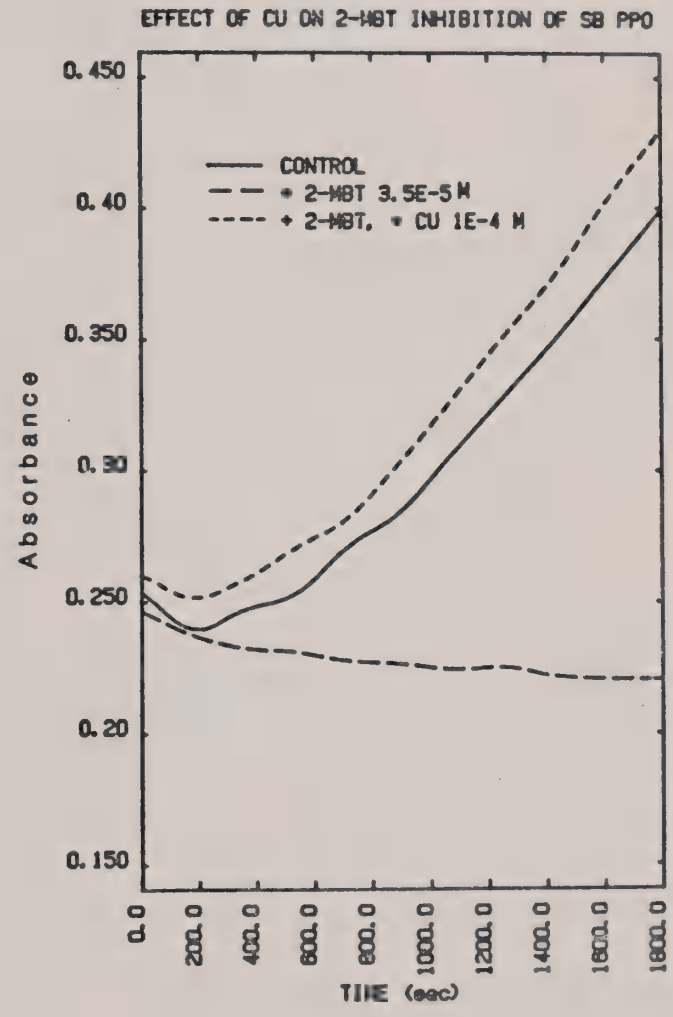


Figure 2. Effect of Cu^{++} in overcoming inhibition of sugarbeet polyphenol oxidase by 2-mercaptobenzothiazole.

SUGARBEET RESEARCH

1985 Report

Section D

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Fargo, North Dakota

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Minn-Dak Sugar Cooperative
Minnesota Agricultural Experiment Station
Sugarbeet Research and Education Board of
Minnesota and North Dakota

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CONTENTS

GERMPLASM ENHANCEMENT AND PHYSIOLOGICAL SELECTION

Devon L. Doney
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I. Beta maritima Collection of Southern Italy, Sardinia and Corsica - June 26 - August 2, 1985

Team Members:

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Domineco Paynona, Southern Italy
Peir Paolo Roggero, Sardinia
Semonetta Bullitta, Sardinia
Henri Laby, Corsica

This plant exploration was a joint effort with the USDA-ARS; the Italian National Council, Germplasm Institute at Bari, Italy; and the French Department de Genetique et d'Amelioration Des Plantes, INRA at Paris, France.

Southern Italy: Collection efforts in southern Italy were centered largely in the Calabria Region and extended along the eastern coast into the Basilicata Region.

Beta maritima was found most abundantly along the beaches and river valleys. Collections were made at the mouth and river valleys of the Brando, Basento, Agri, Sinui, Coscile and Trionto Rivers. Beets were not found in the river flood plains but were found in the cultivated areas and hillsides of the river valleys. The incidence of beet decreased in the upper river valleys.

The best collections were at or near ancient ruins and undisturbed beaches. Farming is very intensive in this area. This intensive farming along with the increased tourism appears to have driven much of the native flora to fence lines and roadsides. The present practice of burning roadsides and fence lines will have the effect of gradually eliminating much of the remaining native flora.

A collection at Point Capa Collonna at the site of an ancient Greek temple showed the most variant of types. The prevailing winds create a constant sea water spray on the B. maritima growing in the rocky cliffs along the shore. These collections should be evaluated for salt tolerance and Cercospora leaf spot resistance.

One of the most prolific and largest populations of B. maritima found in southern Italy was found at la Castella, growing in and around a 15th century castle. The castle was completely separated from the mainland by water. The major flora of this tiny castle island was B. maritima.

The incidence of B. maritima decreased toward the Reggio de Calabria area. Very little Beta was found along the western coastline. Those that were found appeared to B. vulgaris types. An inquiry of local residents indicated that a leaf beet used to be grown in that area as a green vegetable. Collections made in this area may, therefore, be old escaped land races.

Beta macrocarpa has been reported to occur in the Metaponto and Scanzano areas. A careful search in those areas, however, revealed no B. macrocarpa types.

A total of 46 collections were made in southern Italy. The Beta exploration in southern Italy was most timely since it appears that the native populations of Beta are gradually being eliminated as a result of extensive farming, the practice of cutting and burning of roadsides and fence lines, and increased tourist activities.

Sardinia: Wild B. maritima appears to be distributed through Sardinia except in the high mountains on the east coast and in areas of thick Marquis. Apparently, Beta does not compete well with the thick Marquis. We were able to find B. maritima in most farming areas and most beaches.

The area from Oristano to Cagliari is the largest farming area of Sardinia and B. maritima was found throughout most of that area. The farming in Sardinia is not as intensive as in southern Italy and may account for the wider distribution found in Sardinia. However, they also have the practice of cutting and burning the roadsides and fence lines.

We were able to find and sample wild populations of B. maritima in all geographic regions of Sardinia. The B. maritima found in Sardinia appeared to be different from that found in southern Italy. Several collections were noted to have a very thick cuticle, i.e., they had a very leathery appearance. One such collection was obtained at a point near Grotta Verde growing on a granite rock cliff 90 m straight up from the sea.

The collections were obtained in so many different locations under so many different conditions it was difficult to determine true genetic differences. Genetic evaluations under controlled conditions are essential to determine true genetic differences and the value of this collection.

Collections in the Cagliari area (southernmost part of Sardinia) were made July 18-21. Most of the B. maritima in this area were mature and shattered, making it difficult to obtain even a small quantity of seed.

A total of 49 samples were collected from strategic geographical sites throughout Sardinia. This collection should, therefore, represent the genetic variation that exists within the native population of B. maritima on Sardinia.

Corsica: Corsica is more mountainous than either Sardinia or southern Italy, with granite mountains covering almost 90 percent of the Island. Collecting was, therefore, mostly along the sea coast. Several collection attempts in the inland mountains were unsuccessful. Corsica has many beautiful beaches which attract many tourists from Europe. This, along with the

extreme mountainous nature of the Island, made collection in Corsica more difficult. The distribution of B. maritima, although found throughout most of the coastal beaches, was not as widespread and large as in Sardinia. In several gulfs, good populations were found on the south-facing beaches, while we had difficulty finding any B. maritima on the north-facing beaches on the same gulf.

The Beta found in Corsica appeared to be very vigorous and upright. The populations had larger leaves, larger seed, and were taller than those collections made in either Sardinia or southern Italy. A number of collections exhibited a strong hairy or pubescent characteristic.

A total of 23 collections were made on Corsica. The geographic distribution of collections made is fairly representative of the areas where B. maritima occurs.

Earlier workers have obtained some resistance to Cercospora leaf spot from B. maritima. One of our objectives was to observe and collect germplasm containing leaf spot resistance. Leaf spot was observed on some populations but appeared to be absent in other populations. These collections should be evaluated for potential leaf spot resistance.

Throughout the entire collection trip a concerted effort was made to obtain representative samples of the native population. Most collections were bulk population collections. All geographic locations where B. maritima was observed were sampled. This collection should, therefore, represent the genetic variation that is present in the native populations of B. maritima in southern Italy, Sardinia and Corsica. We feel that our efforts were sufficiently thorough that there is no need for future collection of B. maritima in these areas.

All collections were divided with our fellow collectors. A sample of seed from each collection made in southern Italy and Sardinia was sent to the Germplasm Institute at Bari, Italy. Seed collected in Corsica was sent with Dr. H. Laby of the INRA of France.

Seed of each collection will be increased under controlled isolation conditions through a cooperative agreement with Onas Mays at Logan, Utah. The resultant seed increases will be deposited in the NC-7 Regional Plant Introduction Center at Ames, Iowa, as part of the Beta working collection.

Considerable evaluation is necessary to ascertain the merits and value of this collection. Of prime importance is the possibility of resistant genes for Cercospora leaf spot, sugarbeet root maggot and rhizomania. Other horticultural and agronomic properties need to be identified since this germplasm represents gene pools that are different or are new and not present in our current sugarbeet germplasm pool.

II. Evaluation of Wild Beta Species

The Beta maritima, Beta macrocarpa and Beta atriplicifolia collection of John McFarlane has been evaluated at Fargo for self fertility, growth habit and annual vs. biennial habit. A number of those accessions expressing

a semi-biennial to biennial characteristic were tested for Cercospora Leaf Spot resistance in a cooperative trial with Beta Seed Co. at Shakopee, MN.

This collection is very interesting with wide ranges of variation for growth habit, annualness, leaf shape, pigmentation (leaf, stem, petiole and root), leaf pubescence, leaf cuticle, seed cluster size and number, and plant size. Most have long-sprangled-fibrous roots.

Some were crossed to L53CMS (a Logan CMS line with good combining ability). Heterosis was observed in all these crosses with sugarbeet. Some of the F_1's were segregating for biennialism under Fargo conditions. This was unexpected since all the accessions that were crossed to L53CMS exhibited a strong annual habit at Fargo. This may indicate that the annual genes and/or annual modifiers in this material are not the same as the recessive annual gene in sugarbeet. All the F_1's exhibited an enlarged taproot when compared to the B. maritima parent; however, they still retained a considerable amount of sprangling.

Nineteen accessions not producing seed at Fargo were tested for Cercospora Leaf Spot resistance at Shakopee, MN. This was a cooperative test with Karl-Heinz Kersten, Beta Seed Co. Some of these lines had apparently been outcrossed with sugarbeet, as previously noted by John McFarlane. This caused some difficulty in the scoring as well as increasing the scoring variance.

The material was scored 5 times throughout the season (August 1, August 14, August 19, August 30 and September 3). The scores were progressively higher as the infection in the nursery increased. Table 1 gives a summary of the leaf spot score averaged over the five dates.

Table 1. 1985 Cercospora Leaf Spot ratings* for 19 Beta maritima entries - Shakopee, MN.

Entry #	Entry	REP1	REP2	REP3	REP4	AVG
1	WB 41	3.7	3.5		3.8	3.6
2	WB 42	2.7	3.2	3.3	3.5	3.1
3	WB 65	5.2	5.8	5.2	5.2	5.3
4	WB 68	4.2	4.8	4.0	3.8	4.2
5	WB 69	4.7	3.7	5.5	5.8	4.9
6	WB 71	5.5	3.8	5.2	4.0	4.6
7	WB 151	3.7	3.0		3.8	3.5
8	WB 177	3.7	4.0	4.0	3.3	3.7
9	WB 179	3.7	4.0	3.8	3.2	3.6
10	WB 180	3.5	3.5		3.3	3.4
11	WB 181	3.3	3.2	3.8	3.8	3.5
12	WB 182	2.5	2.8	3.3	2.7	2.8
13	WB 184		2.8	2.8	3.5	3.0
14	WB 185	3.6	3.0	3.0	3.8	3.3
15	WB 187	3.7	3.5	3.7	3.3	3.5
16	WB 190	3.0	3.8		3.2	3.3
17	WB 191	4.8	4.2	4.0	4.3	4.3
18	WB 178	4.7	4.0			4.3
19	WB 173	5.7				5.7

Ratings: 1 = no leaf spot; 9 = very susceptible

Several lines (WB 42, WB 182, WB 184) showed significant resistance and should be reevaluated. Although no lines were immune, these resistant materials may represent new genes that are not present in our current sugarbeet germplasm.

III. Physiological Selection

A. Green Leaf Duration: Past studies in cereal genetics have revealed a physiological and genetic relationship between grain fill (grain yield) and green leaf duration of specific leaves. In theory, certain leaves supply the majority of the photosynthate to the developing seed. The longer this source of supply is active the larger the grain and the higher the number of grains.

In sugarbeet, the economic product is not the seed (a reproductive element), but a storage component (sucrose) of the root (a vegetative element). The supply of photosynthate to the root is directly related to sucrose yield. The longer the green leaves remain photosynthetically active the more photosynthate is supplied to the root.

To evaluate this hypotheses two populations (a genetic uniform line = C6600, and a highly heterozygous population = m167) were evaluated in a controlled greenhouse experiment. One hundred fifteen plants of each population were grown in 4-inch pots in the greenhouse. Each pot received identical amounts of fertilizer and were rotated daily. Daily measurements identified the days after planting that the first eight leaves reached the 1 cm, 5 cm, and 20 cm lengths and/or died. At seven weeks after planting, all plants were harvested, roots weighed and dried for dry root measurements.

The C6600 population was used as a measure of environmental variation, since it is very uniform genetically. Significant genetic variation was evident for root fresh and dry weight and percent dry weight in population m167 (Table 2).

Table 2. Variance estimates for root fresh and dry weights and percent dry weight of populations C6600 and m167.

	Variance		
	C6600	m167	F
Root fresh weight	1836×10^3	2868×10^3	1.56*
Root dry weight	7381×10^2	1366×10^2	1.85*
Percent dry weight	411	742	1.81**

* Significant genetic variation at p = 0.05.
** Significant genetic variation at p = 0.01.

Correlations were run for all types of leaf measurements with root fresh and dry weight. Days to death of leaves 1 and 2 were the only measurements that gave significant correlations (Table 3). These correlations were non-significant in population C6600 and highly significant in population m167. There was, therefore, a significant genetic relationship between the time of

Table 3. Correlations of the days to death of leaves 1 and 2 with root fresh and dry weights and percent dry weight for populations C6600 and m167.

Days to Death of Leaves 1 and 2 vs.	C6600	m167
Root fresh weight	0.08^{ns}	0.29^{**}
Root dry weight	0.07^{ns}	0.24^{**}
Percent dry weight	-0.12^{ns}	-0.01^{ns}

** Significant genetic variation at p = 0.01.

leaf dying of the first two leaves and root growth. This data suggests that plants whose leaves remain photosynthetically active longest should produce the highest root yields. The correlations were, however, small and may not be useful in a selection program.

B. Seedling Selection: Seedling selection parameters which indirectly identify superior genotypes for sugar concentration and root yield have been one of our major research efforts. Over the past few years a number of these selection parameters have been investigated. Several have been discarded because of their ineffectiveness in identifying superior genotypes, while some have shown promise and warrant continued evaluation.

This past year five of the most promising seedling parameters were tested in replicated field trials for their selection effectiveness in two divergent heterozygous populations (m167 and g237).

Selection for seedling high percent fiber, low percent fiber, high percent sucrose, high total sucrose and stress were made in populations m167 and g237. Selections for high percent sucrose and high total sucrose were in 5-week-old seedlings whereas the other selections were made in 3-week-old seedlings. Seed increases for each parameter in each population were obtained by planting all selections for each parameter in a separate isolation chamber and allowing them to open pollinate.

The results of the replicated field trials for the two populations are given in Tables 4 and 5. Selections for high and low percent fiber were effective in changing the sucrose concentration in the m167 population but gave no response in population g237. The low percent fiber selection in m167 gave a significant increase in root yield.

Selection for high percent sucrose in 5-week-old seedlings was more effective in population g237. In both populations the sucrose concentration was increased and root yield decreased (Tables 4 and 5).

The high total sugar selection scheme resulted in increases in root yield in both populations with little or no effect on sucrose concentration. Stress selection also resulted in increases in root yield. Its effect on sucrose concentration was positive in population g237 and zero in the m167 population (Tables 4 and 5).

The results in these two populations, though positive, were not significant and consistent. Combining these two tests (Table 6) resulted

Table 4. Sucrose concentration, root yield, and sucrose yield for 5 seedling selection parameters and the parent population (m167).

Seedling Selection Parameter	Sucrose %	Root Yield t/A	Sucrose Yield lbs/A
High percent fiber	13.6	27.2	7367
Low percent fiber	12.2	38.2	9340
High percent sucrose	13.5	29.9	8007
High total sucrose	13.2	33.3	8755
Stress	13.1	33.0	8670
Parent (m167)	13.2	30.9	8135
LSD 0.05	0.7	4.4	1117

Table 5. Sucrose concentration, root yield, and sucrose yield for 5 seedling selection parameters and the parent population (g237).

Seedling Selection Parameter	Sucrose %	Root Yield t/A	Sucrose Yield lbs/A
High percent fiber	14.6	24.2	6803
Low percent fiber	14.7	25.7	7565
High percent sucrose	15.7	23.6	7355
High total sucrose	14.8	29.0	8595
Stress	15.4	28.1	8623
Parent (g237)	15.0	27.2	8117
LSD 0.05	0.6	4.5	1398

Table 6. Sucrose concentration, root yield, and sucrose yield for 5 seedling selection parameters combined over populations m167 and g237.

Seedling Selection Parameter	Sucrose %	Root Yield t/A	Sucrose Yield lbs/A
High percent fiber	14.1	25.7	7085
Low percent fiber	13.4	32.1	8452
High percent sucrose	14.6	26.8	7681
High total sucrose	14.0	31.2	8675
Stress	14.3	30.6	8647
Parents	14.1	29.0	8126
LSD 0.05	0.4	3.1	868

in a significant effect of seedling percent sucrose on harvest sucrose concentration. Selection for low seedling percent fiber was effective in significantly reducing sucrose concentration and increasing root yield. The most promising selection parameters appear to be high total sugar and stress (Table 6). Both increased root yield while maintaining or increasing sucrose concentration.

IV. Transplanting of Sugarbeets Re-visited Using Bare-root Plants (E. W. Scholz, B. Doty, R. Conlon, D. Doney and A. A. Boe)

Last year we tested the transplanting of bare-root plants in the field. The idea was that transplants planted in a southern location might be more hardy, less expensive and give higher returns than the Japanese paperpot method. The pilot test last year was from 5-week-old plants grown in the greenhouse. This test gave positive results and suggested a continued testing of this theory. This year's test consisted of a comparison of transplants grown in a southern location (southern Utah), bare-root plants grown in the greenhouse, Japanese paperpot transplants and direct seeded plots.

Transplant Preparation: Bare-root sugarbeets were sown March 1 in a sandy soil in southern Utah. On April 28 plants were pulled and shipped to Fargo by truck, where they were placed in refrigerated storage until planted.

Another group of plants was planted about the same time in the NDSU horticulture greenhouses using Sunshine mix covered by one inch of white sand as a growing media. These plants were pulled when needed and their tops trimmed; they looked much like the plants from Utah except that a fair amount of the peat moss mixture clung to the lower part of the root.

Paperpot transplants were produced in the greenhouse by the methods described in 1984 but at lower temperatures and with more frequent and vigorous brushing to prevent leaf intertwining.

Planting to the Field: Setting the plants in the field was accomplished at the agronomy farm between Prosper and Amenia, ND, on May 3. Transplanting was facilitated by a Mechanical chain-pocket transplanter. Control plots were seeded with a John Deere 71 Flexiplanter equipped with a beet bottom and adjusted to deliver a seed every 2 inches.

Plots consisted of four rows 50 feet long, all plants spaced at 12 inches in the row. The rows were spaced at 1/2 meter (19.7 inches) because of the one meter wheel spacing of the only tractor available. The complete experiment of six replications was planted in one day.

Results: By the end of the day, problems of moisture deficiency were evident by the wilting of the transplants, especially those from southern Utah. The next day a strong (25-35 mph) dry wind continued the drying of these transplants. The drying was evident to varying degrees in the daytime during the following days. After rainfall on May 9 there was a general recovery of the transplant plots, although the stands of transplants were not good. The number that survived was much greater than expected (Table 7).

Tables 7 and 8 summarize the harvest of samples taken from 25 feet from each of the two center rows of each plot.

Table 7. Stand and yields of transplanted and field seeded sugarbeets at the NDSU agronomy farm, Prosper, ND, in 1985. Planted May 3, harvest October 1. Averages of 6 replications.

Treatment	No. of Beets/ 50 ft row	Mean Wt. lbs/Beet	Yield Tons/Acre
Utah bare-root	19.17 c	3.12 a	15.87 c
NDSU bare-root	31.50 b	2.74 ab	22.90 a
Paperpotted	29.50 b	2.45 b	19.18 b
Direct seeded	48.00 a	1.23 c	5.67 c

Means in a column followed by the same letter are not significantly different at the 0.05 level.

Table 8. Sugar content and sucrose yields of transplanted and field seeded sugarbeets at the NDSU agronomy farm at Prosper, ND in 1985. Planted May 3, harvested Oct. 1. Averages of 6 replications.

Treatment	Percent Sucrose	Percent Sucrose Recoverable	Recoverable Sucrose (lbs/Acre)
Utah bare-root	16.60	14.53	4612 c
NDSU bare-root	16.59	14.48	6632 a
Paperpotted	17.02	15.08	5785 b
Direct seeded	16.42	14.42	4519 c

Means in a column followed by the same letter are not significantly different at the 0.05 level.

Summary: Although stands of only 60 percent were obtained with greenhouse grown bare-root and paperpot transplants and only 40 percent with Utah grown transplants, all produced as much or more sugar than direct seeded beets with a 96 percent stand. The greenhouse grown plants produced yields of over 7 tons per acre more than direct seeded beets and more than 2200 lbs more recoverable sugar. A stand of bare-root transplants improved to that of the direct seeded beets should result in yields great enough to more than cover the costs of plant production and transplanting. There is little doubt that some moisture around the transplants at field setting time would improve the establishment of a stand. We are proposing to continue trials of bare-root transplants by watering in the plants as is presently being done with most vegetable crops.

SUGAR BEET AS A SYMPTOMLESS HOST FOR *CORYNEBACTERIUM SEPEDONICUM*

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Sugar beets contain a wide array of bacteria that not only survive in the root but also multiply there after the root is harvested and stored. Research has been underway to determine if these endophytes might be contributing to the destruction of sucrose in the stored root. During these investigations it was discovered that a species of *Corynebacterium* that had been isolated from a greenhouse-grown sugar beet seedling had a high capacity to hydrolyze sucrose. The identification of this strain was completed because of its sucrolytic activity. The strain was identified as *Corynebacterium sepedonicum*. This finding was considered significant because of the implications it could have on some unanswered questions regarding the epidemiology of ring rot of potato.

The bacterium *C. sepedonicum* causes ring rot of potato by colonizing the xylem vessels and causing wilt. Control of this disease is based primarily on the use of disease-free, or certified ring rot free, seed potatoes. All states that certify seed potatoes have a zero tolerance for ring rot; that is, any detected ring rot causes the rejection of a field or seed lot for certification. North Dakota State Seed Department records showed that nearly 50% of all ring rot cases in North Dakota's seed industry had no traceable inoculum source, which suggests that *C. sepedonicum* survives by unknown mechanisms of which we have no knowledge.

In the study reported here, experiments were performed to show that *C. sepedonicum* can infect sugar beet roots and survive without causing symptoms. Implications for potato culture are discussed.

MATERIALS AND METHODS

Original isolation.--Untreated sugar beet seeds were planted in the greenhouse in nonsterile sandy loam. The seedlings were harvested after 6 wk and the leaves and petioles were removed. The hypocotyls and roots were surface sterilized by first washing in detergent then submerging for 30 secs in 0.1% sodium hypochlorite (NaClO) followed by a sterile distilled water rinse and subsequent submersion in 95% ethanol followed by flame-off of the ethanol. Assay of the surface sterilized root and hypocotyl tissue for bacteria was done aseptically in a laminar flow hood. The tissue was crushed and minced in a small amount of sterile 0.02 M potassium phosphate buffer (KPB) at pH 7.2. Samples of the homogenate were passed through tenfold dilutions of KPB and plated on nutrient broth yeast extract (NBY) agar containing the following ingredients per liter: nutrient broth (Difco) 8 g, yeast extract (Difco) 2 g, K_2HPO_4 2 g, KH_2PO_4 0.5 g, agar 15 g, and added after autoclaving separately, 50 ml of 10% glucose and 1 ml of 1 M $MgSO_4$

$7H_2O$. Isolated colonies were subcultured and identified after incubation for 7-10 days at 23-25 C.

Pathogenicity of a C. sepedonicum strain from sugar beet.--A strain of C. sepedonicum that was recovered from sugar beet was tested for pathogenicity on tomato (Lycopersicon esculentum L.) cv. 'Rutgers'. A strain of C. sepedonicum that was obtained from potato was used as a control. Inoculum of both strains (potato and sugar beet) was prepared by growing the bacteria for 18 hr in NBY broth in shake culture then transferring 1 ml to fresh NBY broth and growing for 6 hr. The bacteria were collected by centrifugation and the pellet was suspended in 10 ml of one-half strength NBY broth and adjusted to 10^6 colony forming units (cfu)/ml from a standard curve that was made at 600 nm. The inoculation was done by making a small hole in the base of the stem of tomato seedlings that had 2-3 leaves. A disposable micropipette tip containing 0.1 ml of the inoculum was inserted into the hole. After the inoculum was absorbed, the micropipette tip was removed and the hole was sealed with petroleum jelly.

Pathogenicity of the sugar beet strain of C. sepedonicum on potato also was tested. Hemispheres of tuber tissue, each with a single sprout about 7 cm long, were excised from tubers using a domestic melon ball scoop. Two balls were prepared from each of cultivars 'Norchip' and 'Red Norland'. Inoculum was prepared similarly to that previously described and adjusted to 10^6 cfu/ml. A disposable micropipette containing 0.1 ml of the inoculum was inserted into each hemisphere at the base of the developing sprout. As before, the micropipette was removed after the absorption of inoculum and the hole sealed with petroleum jelly.

Serological testing.--Two sugar beet strains of C. sepedonicum were tested serologically with antisera produced against potato strains of the bacterium. Rabbit polyclonal C. sepedonicum antiserum was used in immunodiffusion tests and monoclonal antiserum 9A1 was used in immunofluorescence. The monoclonal antiserum used here was the equivalent antiserum from hybridoma cell line 5 which did not react with several species and strains of Corynebacterium. Immunodiffusion tests were conducted as described by DeBoer using culture fluid from pure cultures grown in NBY broth for approximately 2 weeks. Culture fluid from a potato strain of C. sepedonicum prepared by DeBoer was used as a positive control. Immunofluorescence was conducted as described by DeBoer and Weiczorek using 48 hr cultures grown on NBY agar. Three tenfold serial dilutions of the two strains were prepared and examined using an Olympus BH-2 fluorescent microscope.

Artificial infection of sugarbeets by C. sepedonicum.--Sugar beet seeds were planted in 26 cm clay pots containing pasteurized sandy loam soil that had been amended with homogenized tubers showing ring rot symptoms. Three of the pots each contained 1% (v/v) homogenized tubers and three contained 5% (v/v). Three pots were not amended. When the sugar beet roots were 200-400 g in size they were harvested and assayed for C. sepedonicum by first washing the root in detergent then removing 100 g of tissue, peeling off the epidermis then surface sterilizing the tissue by flaming off 95% ethanol. The root was homogenized in a sterile Waring blender flask containing 100 ml of sterile 0.2 M KPB adjusted to pH 7.2. The homogenate was gravity filtered through Miracloth, then through Whatman #1 filter paper, and the filtrate was centrifuged at 4500 g for 1 hr. The extraction and

concentration procedure used was similar to that used by Miller. The filtrate was discarded and the pellet was suspended in a small amount of distilled water and examined for C. sepedonicum using indirect immunofluorescent (IF) microscopy. Positive IF pellets were diluted and plated on NBY agar.

In another test, six sugar beets were grown in the greenhouse in field soil taken from around hills of potato plants exhibiting ring rot symptoms. All roots were harvested and three were submerged in a solution of 0.1% NaClO for 3 days and three were not submerged but placed in a perforated plastic bag at room temperature. The NaClO was changed daily. All roots were incubated three more days after the submerged roots were removed from the NaClO. The roots then were assayed for C. sepedonicum as above.

Field survey for naturally infected sugar beets.--Sugar beet roots were collected in July 1984 from 10 fields selected for their proximity to potato fields. The roots were stored in perforated plastic bags at 4-6 C (ideal storage conditions) for 2-7 mo while awaiting processing. Pellets were prepared from each of 128 roots using the procedure described above except the extract was filtered through sterile nylon instead of Miracloth. Forty 1 of 2-mercapto-ethanol were added per 500 ml of sterile KPB to reduce darkening of the extract. Pellets that contained C. sepedonicum according to the IF test were used to inoculate eggplants (Solanum melongena L.) cv. 'Black Beauty' or tomatoes cv. 'Rutgers' in the 2-3 leaf stage. Inoculation was done by loading two disposable micropipette tips each with 100 1 of the suspended pellet and inserting one tip into the stem about 2 cm above the soil line and the other tip in the stem just above a leaf axil. Disposable 27 gauge syringe needles were used instead of micropipette tips if stems were considered too small for the micropipette tips. Eggplants were inoculated with sterile distilled water as a control. The inoculated plants were harvested 4-6 wk after inoculation to reisolate the bacterium. The petioles were removed and the stem was surface sterilized by flaming-off ethanol. The stems were homogenized in 30 ml of sterile KPB in a sterile Vir-Tis homogenizer flask. The homogenate was centrifuged and the pellet was examined with IF microscopy. The pellets that were IF positive were diluted and plated on NBY agar. Colonies of C. sepedonicum that developed were confirmed by IF microscopy, increased and inoculated into eggplants or tomatoes as before with two inoculation sites per plant at 10^6 cfu/ml. The methods used here to extract and concentrate the bacterium from sugar beet are similar to those used by Miller with potatoes and the enrichment of the bacterium in eggplant is similar to that described by Zielke and Naumann.

RESULTS

Original isolation.--The Corynebacterium that initially was isolated from the sugar beet seedling in the greenhouse was identified as C. sepedonicum. It was a gram positive, slow growing, nonmotile, pleomorphic rod that formed colorless to cream-colored colonies on NBY agar and grew on a nutrient agar medium containing 2,3,5-triphenyl tetrazolium chloride.

Serological testing.--When C. sepedonicum strains from sugar beet were compared with a potato strain in an immunodiffusion test, identical precipitation bands formed between the two strains in response to antibody that had

been formed against the potato strain. The sugar beet strains of C. sepedonicum also reacted positively in immunofluorescence with highly specific monoclonal antiserum.

Pathogenicity of a C. sepedonicum strain from sugar beet.--The sugar beet strain as well as the potato strain caused ring rot symptoms on potato and tomato after inoculation by stem injection (Table 1). Symptoms began on

TABLE 1. Time for onset of symptoms after inoculation of potato ('Red Norland' and 'Norchip') and tomato ('Rutgers') by stem injection of Corynebacterium sepedonicum that was isolated from potato or sugar beet.

Source of C. sepedonicum	'Red Norland'	'Norchip'	'Rutgers'
	days	days	days
uninoculated	- [1]	-	-
potato	67 [2]	59	9
sugar beet	73	68	11

[1] No symptoms appeared.
[2] Average of two plants.

tomato nine days after inoculation with the potato strain and after 11 days with the sugar beet strain. The bacteria were reisolated, increased and reinoculated into the tomato as before. Symptoms began 18 days after inoculation. Wilt symptoms characteristic of those associated with ring rot developed on potato cultivars 'Norchip' and 'Red Norland' 73 and 68 days, respectively, after inoculation.

Artificial infection of sugar beets by C. sepedonicum.--When sugar beets were grown in pasteurized soil that was amended with homogenized ring rot tubers, a positive IF test was obtained from one of the three roots from each amendment treatment (1% and 5%). No positive IF was found in roots from the nonamended control. The C. sepedonicum that was isolated from the dilution plates caused wilt of tomato after stem inoculation.

One of the six sugar beet roots that had grown in naturally infected ring rot soil contained C. sepedonicum as indicated by a positive reaction when the bacterial pellet was examined with IF microscopy. This root was one that had not been submerged in NaClO. The population was judged high but no symptoms developed on eggplants that were inoculated with this pellet.

Field survey.--Of 128 sugar beet roots from 10 fields assayed for C. sepedonicum, 49 roots or 38% were positive for C. sepedonicum when examined with IF microscopy (Table 2). The number of IF positive reacting bacteria ranged from 1-2 to 40-60 per microscope field. Of the 49 positive samples, 29 were considered at a high enough population level (at least 20 bacteria/

TABLE 2. The use of monoclonal antibodies in immunofluorescent (IF) microscopy to detect Corynebacterium sepedonicum in extracts of field-grown sugar beets and the number of eggplants and tomatoes with symptoms after inoculation with IF positive bacteria.

Field		Roots		Symptoms on eggplant/tomato
		Assayed	IF positive	
no.	status	no.	no.	no.
1	APF	12	5	1
2	APF	16	7	
3	APF	10	4	
4	APF/PCP	14	4	
5	IFP	4	1	
6	APF	12	5	1
7	PCP	12	7	1
8	APF	12	4	
9	PCP	22	9	3
10	APF	14	3	
Total		128	49	6

APF = sugar beets from a field grown adjacent to a potato field; PCP = sugar beets from a field grown in a field cropped the previous year to potatoes; IFP = sugar beets from a field that was not near any known potato field.

field) to initiate symptoms if the pellet was used to inoculate eggplant or tomato. Only one eggplant developed ring rot symptoms after inoculation with the 29 centrifuge pellets. Corynebacterium sepedonicum was isolated on dilution plates that were prepared from six pellets from the inoculated but symptomless eggplants. Identification of C. sepedonicum was confirmed by IF microscopy using the monoclonal antibody. Eggplants and tomatoes that were inoculated with sterile distilled water were negative for fluorescing bacteria. Five of the six isolated cultures noted above induced symptoms in eggplant and mild symptoms on tomato after stem injection (Table 2). Therefore, pathogenic strains of C. sepedonicum were recovered from six of 128 sugar beets (4.7% recovery) that were collected from the field.

DISCUSSION

This report presents evidence that the sugar beet can serve as a symptomless host in the greenhouse and in the field for the ring rot bacterium, C. sepedonicum. This conclusion is supported by the recovery of the bacterium from surface sterilized sugar beet roots that had grown in naturally and artificially infested soil from a potato field and from sugar beet roots collected from the field. The sugar beet strain from the original sugar beet seedling reacted positively in double diffusion tests and IF tests with

antibodies produced against a potato strain of the bacterium and produced typical ring rot wilt symptoms on the indicator hosts eggplant and tomato. The experimental procedures we used to arrive at our conclusion are the same basic procedures that have been used to detect latent ring rot infection in potato tubers. Therefore, the long-held assumption that only potato is a natural host for C. sepedonicum is no longer true. These results also suggest the need to reexamine other members of the Chenopodiaceae that are common weed species in potato fields.

Attempts were made to isolate C. sepedonicum from 190 roots that were collected from 19 randomly selected beet fields after the bacterium was isolated and identified from the original sugar beet seedling. This trial failed to detect the bacterium when noncentrifuged root extracts were diluted and plated on nutrient agar. Recovery should not have been expected based on our subsequent experience with centrifuged extracts. The lack of recovery probably was due to the low concentration of C. sepedonicum in comparison to other sugar beet bacterial endophytes in the crude root extract together with the slow growth characteristics of the bacterium. The latter feature is a well known problem that interferes with detection on culture plates because the slow growing C. sepedonicum is overgrown by other bacteria. Detection of sugar beet roots that contained C. sepedonicum was facilitated by concentrating the bacteria from the root extract by centrifugation and labeling the target bacteria with fluorescent antibody. Other researchers have concentrated C. sepedonicum in plant extract by centrifugation to increase the effectiveness of the extract as inoculum. The use of the monoclonal antibody which has specificity only for pathogenic strains of C. sepedonicum aided the identification of the pellets that should be used for stem injection and subsequent confirmation of pathogenicity.

Eggplant and tomato have been used extensively in bioassays for ring rot diagnosis and in research on pathogenesis. Ring rot symptoms on these plants will establish pathogenicity of gram positive strains during diagnosis, compare virulence of strains and detect latent and mild infections in tubers. Our results reveal that symptoms developed on only one eggplant when eggplants and tomatoes were inoculated with 29 IF positive bacterial pellets that were prepared from sugar beet roots. Our experience with this bacterium suggested that symptoms should have developed in more eggplants because of the high population (>20 per microscope field) of C. sepedonicum in these pellets. This consideration is based on a calculation that 5000 bacteria/ml should be in pellet slurries that average two fluorescing cells/microscope field. It has been shown that as few as 10 cells/ml will initiate symptoms when inoculated into stems of eggplant cv. 'Black Beauty'. Other research states that 2×10^3 is the minimum number of cells/ml required to initiate symptoms on eggplant cv. 'Black Beauty'. The absence of symptoms in our experiments prompted the attempt to reisolate the bacterium from the symptomless plants. The bacterium was reisolated from six symptomless plants and symptoms did develop on eggplant after inoculation (at 10^6 cfu/ml) with five of the cultures that were isolated. Even though chlorosis and wilt did develop, symptoms were mild and eggplants seldom died. Unilateral growth of young leaves occurred as described elsewhere. Eggplant cv. 'Black Beauty' is more susceptible than tomato to C. sepedonicum which explains why mild symptoms developed 3 wk later on tomato than on eggplant after stem inoculation with strains that were isolated from eggplant. In addition, potato plants infected with a sugar beet strain developed symptoms, but the

wilt never progressed to the point where the entire plant wilted and died. These results suggest that C. sepedonicum strains from sugar beet are less virulent than potato strains and possess enough virulence to cause symptoms on eggplant and only occasional mild symptoms on tomato. Low virulence also may have accounted for the absence of symptoms when eggplants were inoculated with IF positive bacterial pellets from sugar beet roots that had grown in ring rot field soil. Recent work has confirmed that eggplant cv. 'Black Beauty' is the most suitable host for a bioassay to detect C. sepedonicum and that virulence can be expressed as a delay in symptoms and the number of eggplants showing symptoms depending on the strain of C. sepedonicum.

Other researchers have shown that the percentage of eggplants that develop symptoms increase if they are inoculated with bacteria freshly isolated from eggplants with symptoms. This enrichment procedure apparently contributed toward our success in getting symptoms on eggplants after inoculation with strains that were isolated from symptomless eggplants.

There was no apparent association between potato fields and the prevalence of infected sugar beet roots. This lack of association is supported by earlier work where Corynebacterium sp. was isolated from sugar beet roots from a field where potatoes had never been grown. This suggests that the bacterium may be seed-borne in sugar beet. This hypothesis is supported by the recovery of the bacterium from a 6-wk-old sugar beet seedling that had grown in nonsterile soil in the greenhouse. The probability is remote that a recoverable level of this slow growing bacterium could have developed in the seedling within 6 wk from a soil source. However, a recoverable population may have developed if it was seed-borne.

Sugar beet roots suspected of containing C. sepedonicum were submerged in NaClO to initiate fermentation and deterioration in a sterile medium. We hypothesized that C. sepedonicum might increase to a recoverable level in deteriorating tissue. This was not successful and appears not to be a useful method because none of three roots that were treated this way yielded the bacterium and symptoms did not develop on eggplants after inoculation with pellets.

The recovery of potato strains of C. sepedonicum from sugar beets that were grown in soil artificially amended with ring rot infected potato tubers demonstrates a possible mechanism by which sugar beet may become infected with the bacterium. The evidence that is presented here would strongly suggest that sugar beets aid in the survival of the bacterium. This bacterium can persist in soil and infected potato stems. In North Dakota, sugar beet and potato frequently follow each other in the crop rotation sequence, thus providing either crop the opportunity to become infected with the bacterium that resides in the crop residue. Current ring rot control recommendations in potato include the avoidance of planting potatoes in fields of a previously infected crop. If future field research shows that sugar beet debris is an inoculum source for potato ring rot, this recommendation may need to be expanded to include the avoidance of planting potatoes in fields previously cropped to sugar beets.

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SELECTION FOR SUGARBEET ROOT MAGGOT RESISTANCE

L. G. Campbell

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Fargo, North Dakota

1985 was the second year of a program aimed at identifying and developing sugarbeet breeding lines that will provide commercially useful levels of sugarbeet root maggot (SBRM) resistance. All material was evaluated at St. Thomas, North Dakota, at a site that had been utilized for SBRM evaluations the past few years and provided a relatively high population of maggots. Unfortunately, environmental conditions at the location caused severe stand reductions as the seedlings were emerging. Because of this, the 1985 results should be considered inconclusive until the selected material is tested again next year. Maggot pressure was relatively high and plants with relatively low damage ratings are being increased for further examination.

In the early 1970's, nine accessions of the world collection were identified as possible sources of SBRM resistance. These were evaluated again in 1985. The following appeared to have some SBRM resistance and are being increased for future testing: PI-171516, PI-179180, PI-177276, and PI-181718. A number of biennial Beta maritima accessions were evaluated. The following lines appeared to have some resistant plants: A-4202, A-4212, A-4242, A-4215, A-4217, and A-4219. Also, isolated low-damage plants were saved from several B. maritima lines and will be intermated (A-4220, A-4243, A-4245, A-4250, A-4251, A-4194, A-4213, A-4214, and A-4249).

Preliminary studies of greenhouse screening techniques have begun. Lines which have been selected under natural infestations of SBRM were compared to susceptible lines. Some lines that appear to have some resistance in the field were badly damaged in the greenhouse tests. This suggested that preference may play a role in SBRM resistance, in some lines. Plants selected for low damage in the greenhouse tests are being increased. We plan to evaluate this material in both the field and greenhouse to gain insight into the effectiveness of greenhouse screening.

In addition to the above activities, we are continuing to evaluate the SBRM resistant germplasm that was obtained from Logan, Utah, in 1983 and other adapted germplasm.

SUGARBEET RESEARCH

1985 Report

Section E

Michigan Agricultural Experiment Station,
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Dr. C. L. Schneider, Plant Pathologist
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Dr. G. E. Coe, Geneticist

CONTENTS

Evaluation of Soil-Free Sugarbeet Selections-1985

J. C. Theurer, G. E. Coe, and R. C. Zielke

Eighteen soil-free sugarbeet selections made at Beltsville, MD, by G. E. Coe were evaluated at the B&B Research Farm near Saginaw, MI for yield performance and the quantity of soil adhering to the roots at harvest. Four entries (8250) were 1982 selections, seven (8350)were selected in 1983, and seven (8450) were selected in 1984 from superior soil-free beets in field trials. The two current cultivars being grown commercially in Michigan, GWE4 and USH23, were used as checks. Twelve of the soil-free selections were also grown at Breckenridge, MI. The soil at the B&B Farm is a Charity clay, while at Breckenridge, the soil is a Bixbiro fine sandy loam.

B&B Farm Experiment

Individual field plots consisted of single rows 28" apart and 26 feet in length. The experiment was a randomized block of six replications, planted April 30 and harvested October 29 and 30. In contrast to a similar experiment conducted in the dry season, 1984, this years experiment was harvested when the soil was near water holding capacity. Rainfall in September and October was 6.95,and 6.65 in. respectively. The heavy clay soil adhered to all roots, making it difficult to reliably measure variety differences. Several harvest methods were tried in the first replication to devise a procedure that would provide meaningful results. We selected the method of loosening the roots with a tractor mounted puller, pulling and topping the beets by hand and putting them across the grab roll of our experimental harvester. Roots with greater branching and deeper sutures tended to retain more soil giving us some measure of differences between smooth root genotypes and the checks. All roots of each plot were weighed, adhering soil was removed and beets were re-weighed. A 10 beet sample of clean roots was used to obtain pressed juice for laboratory analysis, for sucrose content and clear Juice purity by the Michigan Sugar Co.

Results: Data from the B&B experiment are shown in Table 1. GWE4 had the highest quantity of soil harvested with the roots but differences between entries were non-significant. The 8250-15 selection was almost as high as GWE4. The soil-free selections had root weight and RWSA equal to the checks but they were significantly lower in sucrose percent. The checks were significantly better for RWST, but they were not superior for quality. The difficulty in harvest this year suggests that selection for soil-free beets should be made on other than a clay soil type.

Breckenridge Experiment

This experiment consisted of 14 entries, in six replications of single row field plots with rows 28" apart and 30 feet in length. It was planted April 30 and harvested October 31. Beets were loosened with a tractor drawn puller, and harvested by hand. Excess soil was removed by gently bumping a pair of beets against each other. All beets from each plot were harvested, weighed, cleaned and re-weighed. A 10 beet sample was used for sucrose and purity determinations which were made by Michigan Sugar Co.

Results: This experiment had an excellent stand, and differences between the smooth root characteristics of soil-free entries were readily apparent upon visual observation. Data is shown in Table 2. The quantity of soil harvested with the soil-free selections was about half of the quantity harvested with the checks. Three selections, 8450-5, 8450-40 and 8450-45 - were the most significant by visual rating on a 1-5 scale as well as noted by soil weight.

The soil free selections had similar RWSA, root weight, and purity as the checks, but were significantly lower in RWST and sucrose percentage.

There was some consistency noted between the two experiments. Entry 1 (8250-15) in both field tests showed the greatest quantity of soil harvested for soil-free selections. Lines 8450-5 and 8450-40 were among the most soil-free varieties at both locations.

Individual root selections were made this year at Breckenridge to continue a breeding program with this material. Also with Dr. Coe's recent retirement, roots selected at Beltsville and seed of 1985 selections will be transferred to East Lansing. Increased sucrose content is a prime requirement for further development of smooth root soil-free germplasm. A program is in progress to enhance sucrose content in this material. Monogerm O-type lines are also being developed so the smooth root character can be utilized both as a male and a female component of a hybrid.

Table 1. Sugar yield, root yield sucrose percentage, clear juice purity and soil harvested with taproots. "Soil-free" Experiment B&B Research Farm - Saginaw, MI 1985.

LIST OF VARIABLES

VAR	TYPE	NAME/DESCRIPTION
2	numeric	Variety code number
3	text 15	Variety name
4	numeric	RWSA = POUNDS RECOVERABLE SUGAR PER ACRE
5	numeric	ROOT WEIGHT - TONS/ACRE
6	numeric	RWST = POUNDS RECOVERABLE WHITE SUGAR PER TON
7	numeric	SUCROSE %
8	numeric	CJP % = CLEAR JUICE PURITY
9	numeric	POUNDS SOIL PER 100 POUNDS ROOT WEIGHT
10	numeric	POUNDS SOIL PER TON OF BEETS HARVESTED

CASE NO.	2	3	4	5	6	7	8	9	10
287	1	8250-15	3890	13.8	284.0	16.51	95.51	7.9	157.2
288	2	8250-50	5508	20.2	275.1	16.12	95.09	5.3	107.3
289	3	8250-105	6364	23.2	274.5	16.17	94.81	4.2	80.5
290	4	8250-144	5748	20.3	284.2	16.55	95.38	5.2	102.3
291	5	8350-7	5965	22.1	270.3	16.02	94.51	6.3	124.7
292	6	8350-16	5178	18.9	274.2	16.05	95.18	5.8	120.2
293	7	8350-23	5735	21.1	272.6	16.07	94.80	7.2	140.3
294	8	8350-26	4683	16.9	275.5	15.97	95.75	6.7	135.2
295	9	8350-37	5901	20.8	282.7	16.49	95.29	6.7	133.7
296	10	GWE4	6029	19.7	306.4	17.74	95.50	8.5	172.7
297	11	8350-111	5410	21.0	256.2	15.39	93.92	6.5	129.8
298	12	8350-116	5751	20.8	276.4	16.12	95.36	7.2	145.7
299	13	8450-5	5430	23.1	236.0	14.12	94.37	4.5	92.0
300	14	8450-23	5611	20.2	277.8	16.17	95.44	5.0	98.8
301	15	8450-29	5902	21.5	273.9	16.10	94.95	5.8	118.8
302	16	8450-30	4883	19.0	259.9	15.32	94.86	4.2	82.3
303	17	8450-40	5331	20.1	265.3	15.65	94.81	4.2	82.8
304	18	8450-45	4916	18.5	268.1	15.68	95.27	4.7	92.7
305	19	8450-50	5780	21.5	267.1	15.77	94.72	5.5	110.5
306	20	USH23	5827	20.1	290.9	16.88	95.53	5.8	115.7
		MEAN	5492	20.1	273.6	16.04	95.05	6.0	120.7
		LSD.05	996	3.5	17.4	0.93	0.56	2.9	57.9

Table 2. Sugar yield, root yield, sucrose percentage, clear juice purity and soil harvested with taproots - "Soil free" Experiment - Breckenridge, MI - 1985.

LIST OF VARIABLES

VAR	TYPE	NAME/DESCRIPTION
2	numeric	Variety code number
3	text 15	Variety name
4	numeric	RWSA = POUNDS RECOVERABLE SUGAR PER ACRE
5	numeric	ROOT WEIGHT - TONS/ACRE
6	numeric	RWST = POUNDS RECOVERABLE WHITE SUGAR PER TON
7	numeric	SUCROSE %
8	numeric	CJP % = CLEAR JUICE PURITY
9	numeric	POUNDS SOIL PER 100 POUNDS ROOT WEIGHT
10	numeric	POUNDS SOIL PER TON OF BEETS HARVESTED

CASE NO.	2	3	4	5	6	7	8	9	10
225	1	8250-15	6318	21.1	299.8	17.53	95.02	26.5	428.1
226	2	8250-144	6754	23.7	284.7	16.66	95.07	10.8	218.5
227	3	8350-23	6364	22.6	283.3	16.70	94.68	9.6	194.0
228	4	8350-26	7162	23.4	306.7	17.71	95.68	11.2	225.5
229	5	8350-37	7798	27.9	280.3	16.43	95.03	11.4	227.6
230	6	8450-5	7128	25.6	278.8	16.19	95.57	8.0	150.0
231	7	8450-23	6183	21.6	288.4	16.89	95.01	11.1	224.8
232	8	8450-29	7696	26.4	291.9	17.06	95.09	10.5	210.2
233	9	8450-30	7757	27.2	286.1	16.69	95.23	13.7	270.4
234	10	8450-40	7031	24.5	286.4	16.75	95.12	7.5	151.0
235	11	8450-45	7475	25.7	291.4	16.97	95.30	7.5	148.0
236	12	8450-50	7621	25.9	295.7	17.15	95.50	11.2	218.8
237	13	GWE4	8175	25.0	326.0	18.82	95.60	27.4	543.8
238	14	USH23	6647	21.5	309.9	17.91	95.63	27.7	553.8
		MEAN	7151	24.4	293.5	17.10	95.25	13.9	268.9
		LSD.05	1325	4.7	14.4	0.59	0.81	6.36	145.8

Studies of Cytoplasmic Male Sterility

J. C. Theurer

In 1985 we continued development of isolines of several potentially different sources of cytoplasmic male sterility by backcrossing to C1 (NB1) O-type and to L60 pollen restorer. The L60 crosses were made each generation by emasculation of the backcross plants. In August we began cooperative research with Dr. Lee McIntosh's lab at Michigan State University to characterize the mitochondrial DNA and proteins of four CMS-C1 isolines

Japanese CMS Sources:

Japanese scientists have published information suggesting that they have derived four new sources of CMS from gamma-irradiation of sugarbeet seed. However, recent correspondence with Dr. Kinoshita indicates that they have not developed O-type or pollen restorer equivalents for these sources, nor are they utilizing the CMS sources in commercial hybrids.

Kinoshita and associates have classified s.s.b. semi sterile plants (defined as yellow anther, non-dehiscent, with 1-20 percent stainable pollen) into the male sterile category in testing their genetic ratios. Questions arise as to the influence of environment on s.s.b. plants and the more important question, relative to having a yellow anther male sterile with as much integrity as observed in currently used white anther CMS lines. Studies are in progress to obtain a better understanding of the potential use of these sources. Results of classification for pollen fertility for crosses with three of these sources are shown below:

Table 1. Japanese ♂ sources of CMS

Source	Fertility classes 1/					
	MSI	MSII	S.S.	S.F.	F.	TOTAL
♂ 60 CMS X L60 F_1	1	1	3	1	2	8
" X " F_2	6	5	1	0	0	12
♂ 114 CMS X L60 F_2	0	3	9	11	12	35
X L53 BC_1	5	4	3	7	0	19
♂ 130 CMS X L60 F_2	10	19	15	7	7	58
X C1 BC_1	15	15	2	3	2	37

1/ MSI = White - Brown anther, non-dehiscent - shrunken immature pollen grains without exine
MSII= Yellow anther, non-dehiscent, non-staining pollen grains with developed exine
S.S.= Yellow-yellow brown anther, poor dehiscence 5-20% stainable pollen grains
S.F.= Yellow-orange anther, fair-good dehiscence 30-70% stainable pollen
F. = Yellow, excellent dehiscence 80-100% stainable pollen

The segregation for fertility varied across the whole spectrum from completely sterile to fertile and was difficult to fit to meaningful genetic ratios. We plan to use cloning techniques to remove some of the extraneous variation due to environment in future studies.

Potential New CMS Sources:

Residual seed of six other sources of CMS brought from Logan were also grown this year to note segregation and obtain new seed increases. Segregation patterns for these sources are listed in Table 2 below:

Table 2. Segregation from potentially different sources of CMS

		Fertility classes					
		MSI	MSII	S.S.	S.F.	F.	TOTAL
A132 Source (Turkish Introduction - Ames NC7 collection)							
CMS X L60	F_1	0	0	0	8	24	32
X	F_2	5.4	15	35	38	4	146
BM Source (Beta maritima)							
CMS X C1	BC_1	5	4	0	1	0	10
X L60	F_1	1	0	5	7	22	35
PR (Powers Red)							
CMS X L26	F_1	2	5	2	5	2	16
X L37	F_1	0	0	0	1	13	14
A1351 (GW Source)							
MS X CT7	F_1	3	13	6	2	0	24
3302 (Holland Source)							
MS X L61	F_1	4	4	1	1	5	15
X L29	F_1	20	0	1	0	0	21
K3 (Klein Source)							
MS X L60	F_2	2	3	1	4	13	23

Pollen Restorers:

Different CMS types in corn and sorghum have been recognized by endonuclease restriction polymorphism and also by pollen fertility restoration differences. In sugarbeets we have few good pollen restorer lines. A series of crosses with eleven potential restorers were evaluated in 1985. Fertility of F_1 progenies with either C1 or L53 CMS are shown in Table 3.

Table 3. Fertility of potential pollen restorers.

	Fertility classes					
	MSI	MSII	S.S.	S.F.	F.	TOTAL
C1CMS X RF4	2	3	4	2	2	13
X RF14	0	0	0	3	17	20
L53CMS X RF19	0	7	5	0	0	12
X RF20	0	0	3	14	0	17
X RF21	6	3	2	3	10	24
X RF22	0	0	4	12	12	28
X RF24	0	0	1	1	1	3
X RF25	1	2	2	2	6	13
X RF26	10	11	1	0	14	36
X RF27	9	5	2	0	15	31
C1CMS X BM.36 Rf	0	0	0	4	24	28

RF14, RF22, and BM.36 Rf show good potential as pollen restorer lines. BM.36 Rf appears to give fertility restoration for both S plasm and the BM CMS source plasm. It is not uncommon for some restorers to restore more than one sterile cytoplasm. For example, the A73 inbred in corn is a pollen restorer for S, T and C types of CMS. We plan to make reciprocal crosses and compare the enconuclease polymorphisms of the S and BM sources to ascertain whether or not they are governed by the same genetic factors.

Ames Collection Male Sterile:

New male sterile sources found in the Ames NC7 collection were crossed with C1 O-type and L60 restorer lines. Some of the new sources appear to be CMS, while others are probably genetic. Segregation for these progenies is shown in Table 4. 84C lines are CMS X C1 crosses and 84R lines are CMS X L60 crosses. Lines having similar numbers are crosses made to the same plant.

Table 4. Fertility segregation in crosses of new male sterile lines with C1 O-type and L60 pollen restorer.

	Fertility classes					
Seed No.	MSI	MSII	S.S.	S.F.	F.	TOTAL
84C23	5	8	1	0	0	14
84C24	6	0	0	0	0	6
84R24	0	1	0	1	2	4
84C25	23	0	0	0	0	23
84R25	0	2	2	0	19	23
84C26	29	0	3	0	2	34
84R26	0	1	1	0	24	26
84C27	20	1	3	0	2	26
84R27	0	0	1	2	35	38
84C28	23	0	0	0	0	23
84R28	0	1	1	0	17	19
84R29	0	0	0	0	23	23
84C30	0	4	5	7	17	33
84R30	0	1	0	2	8	11
84R31	0	2	4	4	17	27
84C32	19	2	2	1	0	24
84R32	0	3	13	4	5	27
84C33	21	0	0	0	0	21
84R33	0	0	0	0	22	22
84C34	0	0	0	0	16	16
84R34	0	0	0	0	3	3
84C35	12	5	2	2	0	21
84R36	0	0	0	1	15	16
84C37	30	0	0	0	0	30
84R37	0	0	0	0	6	6

Notes on Genetic Marker Stocks of Sugarbeet

J. C. Theurer

Genetic markers may not be useful per se in the development of superior varieties of sugarbeet, but they are often used in breeding strategies. The (R) color gene, (B) annual, and (a) genetic male sterility are well known examples of sugarbeet characters that are useful breeding tools. Chlorophyll mutants may even have utility, based upon the demonstration by Burton (1985) for recognizing heterotic blocks of favorable yield genes in pearl millet, providing a sufficient number of different ones are identified and their association with linkage groups is known. In sugarbeets we are limited by the small number of markers we have and by the limited knowledge of linkage relationships. Part of our research program is aimed at developing a good source of marker genes.

In our collection of genetic markers we have four chlorophyll mutants, one semi dwarf, a ruffled petiole and broken mid-rib character that we have not studied for inheritance. Ruffled petiole may be allelic to feather leaf, and a new virescent may be the same or different from vi_4. Crosses were made in the 1984 greenhouse and the F_1 progenies observed in 1985 indicate that these traits are recessive. Linkage studies are being made with these and other markers.

A new male sterile stigmoid mutant having 12-15 flowers in a cluster like grapes was discovered this year in a plant from the NC7 Ames Beta collection. This plant was cloned for future study.

The broken mid-rib character, when first discovered had low expressitivity with only 2-3 leaves on a plant exhibiting the characteristic 2-4 mm protubrance of the mid-vein from the center of the lamina. By recurrent phenotypic selection we have developed a line that shows high expressitivity in the greenhouse. The protruding mid-vein is observed on all of the first rosette of leaves on transplanted steckling beets. In addition an adventitious bud is produced on many of the mid-vein protrusions. They look like shoot cultures growing out of the center of the lamina. There is a pulse effect in that leaves produced after seedstalk initiation do not show deviation from normal. This line will be studied by Dr. Saunders to determine if it carrys genetic factors that might enhance plant regeneration.

One Step Shoot Regeneration from Callus of Whole Plant Leaf Explants

Joe Saunders

Callus was induced on blade and petiole explants from greenhouse grown plants when they were cultured on Murashige-Skoog based medium with 1.0 mg/L 6-benzyladenine (BA) at 31^{o} C in the dark. This system is similar to the callus induction system seen earlier with in vitro shoot cultures, with callus first being seen only after 3-4 weeks. All callus tested has been capable of sustained growth on medium without growth regulators. It is an unconventional callus, quite like a cancer. It would be of some interest to know what keeps it in check in the whole plant.

In many cases callus went on to regenerate shoots in the same culture plate. Only one explant was placed per petri plate (in contrast to earlier practice) and this greater availability of nutrients and hormone usually permitted callus the time to regenerate. Some plants from the five germplasm lines tested (C566, FC607-0, SP6926-0, EL44, and EL45) gave explants that regenerated shoots directly from callus on the explant.

Optimal concentration of BA for callus induction as well as shoot regeneration turned out to be 1.0 mg/L. Incompletely expanded leaves were much more responsive than fully expanded leaves. Blade explants were superior to petiole explants for callus induction from more fully expanded leaves. This method could be used for gene transformation attempts with Agrobacterium tumefaciens.

Somaclonal Variation for in vitro Behavior in Sugarbeet

Joe Saunders

6926-0-3 has been a standard genotype used for shoot regeneration experiments at East Lansing the last several years. It is a single plant from SP6926-0 selected for good regeneration. Approximately two dozen plants have been regenerated from callus of 6926-0-3. Four, including one each with larger and smaller leaves, were tested with control plants of 6926-0-3 derived from shoot culture. Leaf explants from greenhouse plants were put onto Murashige-Skoog medium with either 0 or 1.0 mg/L BA. The narrow leaf regenerant produced shoots on nearly all callus, only a few days after the callus appeared. Other regenerants resembled the control in lower proportion of calli regenerating and several week interval between callus appearance and shoot regeneration. The narrow leaf regenerant alone could produce callus and shoots on medium without BA.

Somaclonal variation like this for in vitro behavior is a concept that has received minimal mention in the literature. It should be a way of selecting for improved growth or regeneration response in many genetic backgrounds.

SUGARBEET RESEARCH

1985 Report

Section F

Field Crops Laboratory, Plant Genetics and Germplasm Institute, Beltsville Agricultural Research Center-West, Beltsville, Maryland

Gerald E. Coe, Research Geneticist

Cooperation:

Michigan Agricultural Experiment Station

This research was supported in part by funds provided through the Beet Sugar Development Foundation (Project 26)

CONTENTS

Breeding Sugarbeets for Resistance to Black Root and Leaf Spot

G. E. Coe

Research work on sugarbeets at the Agricultural Research Center, Beltsville, Maryland was directed toward improvement of sugarbeet germplasm resistant to Aphanomyces black root and Cercospora leaf spot, important diseases in eastern United States. Emphasis was placed on the production of germplasm with "soil-free" taproots to eliminate mechanical cleaning and for possible use in transplanting operations. In addition, efforts were continued to develop: 1) germplasm with resistance to southern root rot (Sclerotium rolfsii) for use in southern United States where the disease is endemic; and 2) germplasm combining high tonnage with average sucrose percentage as a possible source of fuel alcohol. Sixteen germplasms containing our most advanced developments were released in 1985.

Testing for Leaf Spot Resistance

A good leaf spot epidemic was obtained at Beltsville in 1985. Results of the 1985 nursery are presented in Table 1.

TABLE 1. Results of the Beltsville Leaf Spot Test in 1985

Description	No. Breeding Lines Tested	Av. Leaf Spot Rating*			
		Breeding Lines	USH23	E4	Resistant Check
Beltsville MM BRR-LSR Lines	68	3.0	4.0	4.8	2.3
Beltsville mm BRR-LSR Lines	33	2.8	4.3	3.0	3.2
1984 Soil-free MM BRR-LSR Lines	86	3.2	4.4	4.6	2.9
Experimental Hybrids (83302-0 pollinator)	16	2.9	5.3	5.0	2.2
$F_{2\ \&\ 3}$ Sugarbeet X Fodderbeet	37	2.6	4.7	3.3	3.0
$F_{2\ \&\ 3}$ Fodderbeet X Sugarbeet	18	2.7	4.3	3.0	3.3
Late Planting					
Soil Free MM BRR-LSR Lines	53	3.1	4.8	--	2.9
East Lansing MM BRR-LSR Lines	97	3.3	4.8	3.8	2.9
East Lansing mm BRR-LSR Lines	30	3.3	5.0	4.3	3.1

* Leaf Spot Scale: 0 = No Spots; 10 = All leaves dead

The data confirms what has been shown in test of previous years, namely, the breeding lines are more resistant to leaf spot than either USH23 or MonoHy E4. The performance of the commercial check variety, MonoHy E4, wasn't as good in some experiments as it has been in previous years. The descendants from the sugarbeet X fodderbeet crosses appeared to be very resistant. It isn't clear whether this is true genetic resistance or if it is apparent resistance due to increased foliage vigor. In either case it represents field resistance. More than 95 percent of all the breeding lines tested are more resistant than the best commercial hybrids.

Testing for Black Root Resistance

Greenhouse black root resistance tests were conducted on 1984 seed productions in the winter of 1984-85. Results of these tests are presented in Table 2.

TABLE 2. Results of Testing 1984 Seed Production for Black Root Resistance

		Av. Black Root Rating		
Description	No. Lines Tested	Tested Lines	Resistant Check (SP83301-00)	Susceptible Check
MM from Black Root Selections	107	103	100	115
MM from Leaf Spot Selections	91	105	100	117
mm from Leaf Spot Selections	58	106	96	119
"Soil-free" mm	42	113	94	124
"Soil-free" MM	40	107	95	121
F_3 of Sugarbeet X Fodderbeet	40	101	95	130
F_3 of Fodderbeet X Sugarbeet	19	107	95	130

* 140 = Death of all plants; 80 = No infection

Two resistant check varieties were used in these tests. The numerical ratings were based on the average rating of these 2 resistant check lines and arbitrarily given a value of 100. Hence, the resistant check SP83301-00 was more resistant than the other resistant check as indicated by its average rating of less than 100 in most of the tests. (SP 83301-00 is the progenitor of SP85303-0 released in 1985). The ratings of the susceptible check and the tested lines appear slightly higher than last year mainly because the resistant checks are more resistant. The "soil-free" monogerm lines are the least resistant group of breeding material because they came from 0-type monogerms where great emphasis was not placed on high black root resistance. Of special interest is the apparent high resistance of the F_3 progenies of sugarbeet X fodderbeet crosses. Most of the genetic resistance

comes from the sugarbeet parent, but good seedling vigor probably contributed to the apparent resistance. There appears to be a cytoplasmic influence since the recriprocal F_3 progenies (in fodderbeet cytoplasm) do not exhibit as high a degree of resistance. Except for the "soil-free" monogerms the lines tested can be characterized as having good resistance.

Testing for Resistance to Southern Root Rot

In 1984, screening test were run on progenies of plants selected for resistance to southern root rot (Sclerotium rolfsii). There was a maximum of 16 plants (usually not less than 14) inoculated. In 1985, 15 of the more resistant progenies were retested on a larger scale (a maxiumum of 96 plants of each progeny were inoculated, but usually not less than 92 plants) in order to check how consistent the testing is, and to be sure progenies with poor resistance were not included in seed increases. Results of these tests are presented in Table 3.

TABLE 3. Results of successive tests of progenies for southern root rot resistance.

	1984 Test		1985 Test	
Seed No.	Disease Rating*	Hypocotyl Diameter	Disease Rating*	Hypocotyl Diameter
83 Inc. 6322-0	100	100	100	100
8422-4	79	109	72	116
8422-12	90	110	76	116
8422-19	75	109	84	102
8423-4	76	108	70	111
8423-13	73	103	86	103
8423-14	73	114	84	107
8424-5	95	117	75	140
8424-8	91	128	85	132
8424-9	89	131	69	130
8424-14	80	109	88	100
8424-15	96	100	98	107
8424-17	99	103	91	94
8424-18	90	90	83	101
8424-21	87	105	97	98
8434-0	87	89	83	105
Average	85	108	83	111

* Lowest numerical rating indicates the most resistance. The average disease rating of the other progenies in the 1984 tests was 99.

The correlation between the disease ratings in 1984 and 1985 was not significant at only r=.223. This lack of consistency between tests doesn't mean that the test is ineffective in testing and selecting for resistance to southern root rot. It simply indicates reduced efficiency in making selections. Note that in 1985 two of the lines exhibited only slightly more

resistance than the unselected check (83 Increase of SP6322-0), while the other 13 exhibited fair to good resistance. The average resistance in the 1984 tests was very close to that in the 1985 tests. With regard to hypocotyl diameters compared to the disease ratings, there was essentially no correlation, r=-.001, in the 1984 tests, whereas, r=-.597* in the 1985 test. The correlation between the hypocotyl diameters in the 1984 and 1985 tests was r=.721**. Why hypocotyl diameter didn't influence the disease ratings in 1984 is not understood.

Selections from the best 13 progenies were thermally induced in early spring 1985 and a seed increase was made. This line was designated SP8540-0 and was released. SP8541-0 is a seed increase of selections from the previous generation and was also released. These two breeding lines were tested in a greenhouse disease test in the winter of 1985-86. SP8540-0 exhibited 5 rating points more resistance than SP8541-0. However, SP8541-0 was released because it exhibited good root and foliage vigor. The relative vigor of SP8540-0 is not known at this time.

Development of Soil-Free Sugarbeet Taproots

Test of "soil-free" sugarbeet breeding lines at Beltsville in 1985 indicated little if any change from the results of the 1984 tests. Leaf spot resistance, root yield, and percent nonsucrose solubles are quite acceptable. There is perhaps a slight improvement in the freedom-from-adhering-soil characteristic although there is still considerable variation between and within progenies. The weak spot is the low percentage of sucrose. Selected soil-free multigerm plants were crossed with our highest sucrose multigerm selections having ordinary-type tap roots. Seed of this cross has been sent to East Lansing, Michigan for further breeding and selection. Selected roots of the soil-free lines are being stored at Beltsville and will be sent to East Lansing this spring.

Sugarbeet X Fodderbeet Breeding

Results of testing of eleven F_3 lines in 1985 from sugarbeet X fodderbeet crosses are highly encouraging. Results of this test are presented in Table 4.

TABLE 4. Test Results of F3 lines from sugarbeet X fodderbeet crosses at Beltsville in 1985.

Variety Number	Leaf Spot Rating	Black Root Rating	Gross Sugar lbs./A	Root Yield T/A	Sucrose %	NSS %	RJAP %
SP83301-00	---	95	---	---	---	---	---
USH23	4.7	115	6,351	23.01	13.80	2.30	85.71
MonoHy E 4	3.3	---	8,809	29.82	14.77	2.54	85.33
SP84803-04	2.7	104	8,961	30.69	14.60	1.83	88.86
SP84803-05	2.7	99	8,268	29.89	13.83	1.64	89.40
SP84803-06	2.0	99	9,110	30.51	14.93	2.14	87.46
SP84803-07	2.0	104	7,188	25.01	14.37	2.34	86.00
SP84803-08	2.7	99	8,992	31.82	14.13	1.98	87.71
SP84803-09	2.3	102	10,356	33.47	15.47	2.00	88.55
SP84803-010	3.3	107	7,297	26.19	13.93	1.57	89.87
SP84803-011	2.7	112	8,514	31.84	13.37	1.66	89.86
SP84803-012	2.0	96	8,711	28.71	15.17	1.28	92.22
SP84803-013	2.3	93	9,229	31.67	14.57	2.03	87.77
SP84803-015	2.0	95	7,949	27.28	14.57	1.93	88.30
Average of Test Lines	2.4	101	8,598	29.73	14.45	1.85	88.73

In the leaf spot and black root testing sections of this report the excellent resistance to these two diseases was already noted. In table 4 the average root yield and sugar percentage is only slightly less than MonoHy E4. The average percent of nonsucrose solubles (NSS) is only 73 percent of E4, and the average raw juice apparent purity is more than 3 percentage points higher than E4. SP84803-09 performed especially well having the highest root yield, the highest percent sucrose and a low content of NSS. This breeding material is certainly worthy of further breeding work and testing in hybrid combinations. It has been sent to Dr. J. Clair Theurer at East Lansing, Michigan.

F_3 breeding lines from the recriprocal of the sugarbeet X fodderbeet crosses were also tested in the Beltsville nursery in 1985. These, of course, have cytoplasm from the fodderbeet parent. Test data for 15 of these lines are presented in Table 5.

TABLE 5. 1985 test data on some F_3 fodderbeet X sugarbeet lines*.

Seed Number	Number Roots Rts/A	Leaf Spot Rating	Black Root Rating	Gross Sugar Lbs./A	Root Weight T/A	Sucrose %	NSS %	RJAP %
MonoHy E4	29,800	3.0	---	8,298	24.74	16.77	2.78	85.78
USH23	25,400	4.3	115	8,137	28.39	14.33	2.52	85.04
SP84801-4	21,800	3.0	104	7,672	28.06	13.67	2.55	84.28
SP84801-6	16,700	2.3	106	7,435	28.10	13.23	2.56	83.79
SP84801-8	20,300	2.0	98	7,610	28.04	13.57	2.78	83.00
SP84801-9	15,600	2.0	102	7,850	27.64	14.20	2.86	83.24
SP84801-10	19,600	2.0	99	8,099	28.66	14.13	3.06	82.68
SP84801-11	16,300	2.7	108	6,444	24.54	13.13	2.65	83.21
SP84801-12	23,200	2.3	101	8,458	29.51	14.33	2.24	86.48
SP84801-13	23,600	2.7	106	8,865	32.05	13.83	2.41	85.16
SP84801-14	16,700	2.7	98	7,694	27.48	14.00	2.55	84.59
SP84801-15	18,900	2.7	105	7,684	27.84	13.80	2.58	84.25
SP84802-04	25,700	2.0	105	8,845	28.17	15.70	2.56	85.98
SP84802-06	21,100	2.3	114	9,292	30.80	15.07	2.70	84.81
SP84802-07	18,900	4.0	121	5,046	18.02	14.00	3.21	81.35
SP84802-010	17,000	2.7	107	7,470	28.19	13.25	2.52	84.02
SP83803-4	35,000	3.8	107	10,375	39.98	13.17	2.56	83.73
Average of Test Lines	20,700	2.6	105	7,923	28.47	13.94	2.65	84.04

* 4 Lines with less than 15,000 plants/acre not included in table.

These breeding lines are good in many respects, but they aren't as good as the F_3 lines from the sugarbeet X fodderbeet hybrids. In particular, they are considerably higher in NSS resulting in a much lower raw juice apparent purity (RJAP). Slightly lower percent sucrose also contributes to the lower RJAP. Although the resistance to leaf spot and black root is quite good it is slightly less than the F3 lines from the sugarbeet X fodderbeet crosses. It should be noted, that one line yielded almost 40 tons of roots per acre and that two lines had over 15 percent sucrose. Thus, some are worthy of further breeding efforts.